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THE VIRGINIA JOURNAL OF SCIENCE

A JOURNAL ISSUED QUARTERLY BY THE VIRGINIA ACADEMY OF SCIENCE

Vol. 2, New Series APRIL, 1951 No. 2

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VOL. 2, NEW SERIES APRIL, 1951 No. 2

THE VIRGINIA JOURNAL OF SCIENCE

PUBLISHED FOUR TIMES A YEAR: IN JANUARY, APRIL, JULY AND SEPTEMBER, BY THE VIRGINIA ACADEMY OF SCIENCE

Printed by the Commonwealth Press, Inc., Radford, Va.

CONTENTS

Development of the Science of Bacteriology—WILSON B. BELL.... 81- 90

Isolation of a Virus Causing Granulosis in the Red-Banded Leaf Roller—HARRIETTE BLOCK WASSER & EDWARD A. STEINHAUS 91- 98

Prediction of Subsonic Pressure Distributions By The Sound-Space Theory .....—ROBERT WESLEY TRUITT 94-101

The Life History of *Gerris Canaliculatus* Say In Virginia (Hemiptera: Gerridae) .....MARVIN L. ROBB 102-108

A Report on the Effect of Ethylene Dibromide Soil Treatment on Root-Knot Control, Nodulation, and Yield of Peanuts —LAWRENCE I. MILLER 109-112

Protective Behavior and Photic Orientation in Aquatic Adult and Larval Two-Lined Salmanders, *Eurycea b. bislineata* x *cirrigera*.....—JOHN THORNTON WOOD 113-121

A New Crayfish of the Genus Orconectes from Southeastern Virginia (Decapoda, Astacidae).....—HORTON H. HOBBS, JR. 122-128

News and Notes 129-142

Program for the Twenty-Ninth Annual Meeting of the Virginia Academy of Science 143-171

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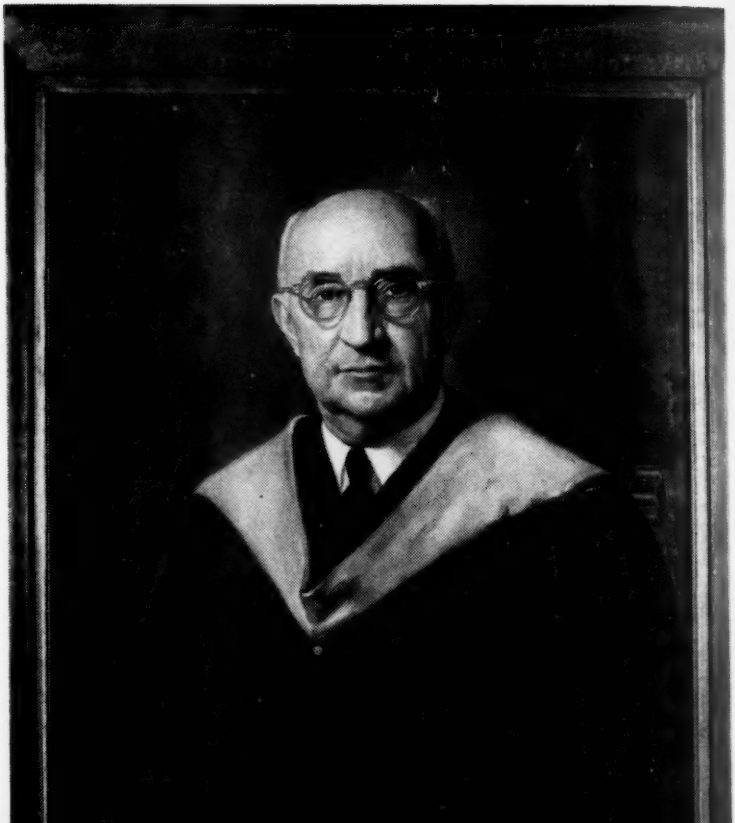
Entered as second-class matter January 15, 1950, at the post office at Blacksburg, Virginia, under the Act of March 3, 1879. Subscription—$3.00 per volume. Published at Blacksburg, Va.

Mailed April 16, 1951



WORTLEY FULLER RUDD

THE VIRGINIA JOURNAL OF SCIENCE

Vol. 2, New Series No. 2

Development of The Science of Bacteriology

Wilson B. Bell

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Everyone, as it has been suggested, has an interest—a vital, though perhaps unrecognized, interest in bacteriology. Only a few, of course, concern themselves with it out of intellectual curiosity; only a small minority finds satisfaction in knowing about the microorganisms that populate the air, the soil, the water; that inhabit man, the lower animals, the plants; that may be beneficial, harmless, or destructive. But none of us who eats, who suffers the common cold, who cultivates the soil, who processes food, or who uses a variety of commercial products, can be indifferent to this science.

Bacteriology, as a science, is of relatively recent origin, but in its short life there have occurred many dramatic revelations concerning the origin and nature of living things. It's real beginning lies with the early questioners of the nature of the universe who, no doubt, considered the possibility of forms of life too small to be seen by the inadequate human eye. Many early beliefs and superstitions were detrimental in that studies were retarded; yet, on the other hand, these beliefs and superstitions were beneficial in that they stimulated scientific testing of their validity. Proof of the existence of microscopic living forms had to await the development of mechanical devices and techniques that enabled man to probe beyond the limits of his vision.

Microscopy preceded, therefore, the discovery of bacteria by Leeuwenhoek in 1676. Prior to this time, magnifying instruments and microscopes had been in use, and their importance in studies of small things was generally recognized. Leeuwenhoek was the first to devote himself diligently to exploration of the microscopic world surrounding him and to write extensively of the microorganisms he found on every hand. The importance of his observations was not immediately recognized, however, and almost a hundred and fifty years passed before this new knowledge was applied.

The development of bacteriology was influenced by the theories,

Editor's Note: In continuing the policy established by the Editorial Board to present in the first three numbers of each Volume of the Journal an article of general interest and progress in the several fields of science, we have invited Professor Wilson B. Bell, of the Department of Biology at the Virginia Polytechnic Institute and Virginia Agricultural Experiment Station, to contribute this article from the field of Bacteriology.

beliefs, and superstitions that prevailed before and even after the significance of Leeuwenhoek's work was recognized. The investigations subsequent to the discovery of bacteria followed two main routes: the study of the nature and classification of the organisms, and the study of the relation of bacteria to disease, putrefaction and fermentation. Several factors gave impetus to the development of bacteriology. The first of these was speculation about the origin of life, and many of the intellectually curious, unconvinced that life began by spontaneous generation, attacked the question by experimentation with microbes. A second factor that hastened the development of the science was the interest in fermentation which had always aroused considerable curiosity and to which Biblical reference was made. The third factor that stimulated the growth of bacteriology was an interest in disease. Man has always been plagued by disease, and many of the beliefs and customs existing at the time of the discovery of bacteria were based on ideas of the cause of disease.

It is impossible to chart completely within the limits of this paper the growth of bacteriology and to indicate the significance of all its findings. There were, however, certain influences and discoveries that shaped its growth, that served to explode existing theories, and that profoundly influenced the later development of the science. These will be discussed under the terms: (a) spontaneous generation, (b) fermentation, (c) disease, and (d) classification. In order to follow this development it is necessary to consider briefly within each group the theories that existed at the time of the beginning of bacteriology.

SPONTANEOUS GENERATION

The origin of animals and plants has been a source of speculation since the beginning of time. The ancients believed that animals and plants whose parents could not be seen arose as the result of the combined action of heat, air, earth, and putrefaction. Aristotle described instances of spontaneous generation, and this concept was dominant through the Middle Ages; as late as 1652 van Helmont gave directions for the generation of mice from dirty clothes and fermenting grain. Redi (1668) challenged the idea by showing that maggots in meat were really the offspring of flies and that no visible worms or insects appeared in meat which was protected by gauze so that flies could not reach it during decomposition.

Spontaneous generation as the origin of some forms of life gradually lost credence insofar as the highly organized forms were concerned. The discovery of bacteria by Leeuwenhoek revived the idea, however, and many believed that spontaneous generation was the rule for the microscopic creatures. Rapid steps in the advancement of bacteriology came as the result of attempts to prove that bacteria did not generate in this manner.

Joblot (1718) may have made the first experiments when he heated

infusions and showed that such infusions in closed vessels remained free from life but that the infusions in open vessels soon teemed with animalcules. This was not considered conclusive, and the idea of spontaneous generation continued to be supported by many. Needham, for example, observed innumerable small moving objects in germinating seeds and conducted an experiment to prove that they came from the infusion itself. He sealed hot mutton gravy in vessels, and observed the development of growth, even though the flask had been heated after sealing. He believed in a vegetative force in the microscopic particles of organic matter which allowed the matter to become alive.

Spallanzani in 1765 made known the results of his first work. He had repeated the work of Needham and improved on the technique. He exercised greater care in sealing and heating the flasks, and his results did not agree with Needham's. Spallanzani used many types of flasks and many methods of sealing them, finally resorting to hermetic sealing. As a result he concluded that it was not enough to seal the vessel properly, but that the included air must also contain no animalcules, and that, if such conditions existed, no growth would occur in boiled infusions. He tried other methods such as diluting broth until a single drop contained only a few microbes and observed them divide until the drop was cloudy. For this he is credited with being the first to observe microbial division. Needham replied that the heating destroyed the vegetative forces, and the controversy continued.

Schulze in 1836 conducted an experiment that showed the relation of air to the doctrine of spontaneous generation. He boiled an infusion, and while the steam was coming from two tubes that passed through the cork seal of the flask, attached the tubes to bulbs, one containing sulfuric acid and the other caustic potash. From May to August air was pulled into the infusion flask through the acid, but the infusion remained sterile until it was finally directly exposed to the air. The air in the flask was thus shown not to cause growth. Attempts by others to repeat the work failed. Tyndall also became interested in the question and found that in the absence of dust particles infusions remained sterile.

Other and more elaborate experiments were conducted by many whose curiosity was stimulated by the debate. Attempts to refute Spallanzani and Schulze were made by many, especially Pouchet (1859). Pasteur became interested in the problem and conducted a series of investigations that refuted completely the theory of spontaneous generation and at the same time established principles of research that made a marked impression upon bacteriological investigation.

Pasteur demonstrated that air contained germs by means of filtering it through cotton-wool. The microorganisms were deposited and a single fiber, when dropped in a sterile nutrient fluid would bring about rapid growth. After showing that germs or microbes existed in air, Pasteur proceeded to demonstrate that boiled infusions could be kept sterile in

open flasks, provided the necks of the flasks were drawn out and so curved that the dust or germs in the air could not ascend into the flask. Many types of flasks were designed, but invariably the infusions remained uncontaminated in flasks, the necks of which caused the microbes to settle out before entering the flasks proper. By simply tilting such a flask until the liquid entered the neck and contacted the deposited dust and microbes, Pasteur showed that contamination readily occurred.

Pasteur's work was confirmed by others and disputed by some. The problem of why some sterilized nutrients became contaminated was still unanswered until Cohn (1876) recognized the spores of bacteria, discovered that they were capable of germinating and that they were very heat-resistant. Tyndall also observed the spores and became familiar with their nature and their resistance.

The controversy about spontaneous generation was finally refuted by men who used microbes in their experimentation. The work done revealed many significant facts about the nature of bacteria, their reproduction, the resistance of the spore form and about sterilization of nutrients and the protection of sterile fluids. Lister immediately used this new information by stressing the necessity of sterilizing all glassware by heat and later expanded this doctrine for use in surgical procedures. The controversy resulted in carefully planned experiments, sharp criticism, and repetition of work, using the knowledge already gained. Such practices are still dominant in investigations in the field of bacteriology.

FERMENTATION

Early recognition of the communicable nature of the changes now known as fermentation is indicated by Biblical statements. It was not until the nineteenth century, however, that the process began to be understood. Willis, in 1659, approached a chemical explanation when he explained the process as an internal commotion of the particles of the fermentable material. This idea influenced the chemistry and bacteriology in the following years and is expressed often in the literature.

In the first part of the 19th century yeast was found to be a living substance. Cagniard-Latour in 1836 stated that yeast was a living thing; in the next year he suggested that fermentation was the result of yeast action. Schwann also recognized the true nature of yeast and described its connection with fermentation. They caused the fermentation of sugar solutions, according to Schwann, because: 1) they were always present in the process, 2) fermentation ceased when they were destroyed, and 3) because the fermentation must be due to an agent that is regenerated and increased in the process, a condition attributable to living organisms.

This biological theory of fermentation was opposed mainly by chemists under the influence of Berzelius, Wohler, and Liebig. Wohler had synthesized urea, previously found only in the living body, and

Liebig was attributing a chemical character to all vital processes. Liebig expressed the view that fermentation was due to the instability of substances which could transmit their instability to other substances. The ferments were the unstable substances that appeared as the result of changes in solutions exposed to air. Mitscherlick (1841) expressed the view that yeast was necessary for fermentation but that it was not itself the effective agent.

Pasteur became interested in fermentation and in 1857 reported his first observations on the process. In studying lactic fermentation he noted a substance either deposited in or floating on the surface of the fermenting fluids. Microscopically this substance consisted of tiny globules or short pieces, alone and in masses. A small amount of this substance would cause fermentation when placed in a new sugar solution, and the process could be repeated over and over, with exactly the same results. Pasteur concluded that the substance was living and that the fermentation was due to its organization and growth. He also showed that the ferment came from the air, for, when he used sterilized solutions and allowed only heated air to enter, fermentation did not occur. From lactic fermentation Pasteur proceeded to study butyric and acetic fermentations and wrote extensively of his findings. During these studies he recognized abnormal processes that destroyed wines and evolved principles for reducing such troubles.

The idea that fermentation might not be the result of the vital activity of these organisms was held by some. Efforts to demonstrate the presence of a soluble ferment or enzyme met with failure until Buchner produced zymase from yeast juice and found that it could cause alcoholic fermentation of some sugar solutions. This was followed by extensive work, some of which confirmed the existence of a soluble ferment and some of which went even farther by recognizing that other factors, such as co-enzymes, were also involved.

The debate concerning the nature of fermentation was finally ended by use of bacteriological techniques. Of more value perhaps than the mere settling of a moot question was the great advancement made in understanding the nature of the process, the control of the process, and the recognition of aerobic and anaerobic life. It was in these studies, made to satisfy academic questions, that the basis for industrial fermentations was laid. The production of alcohols, organic acids and glycerol, the flavor and composition of certain foodstuffs, the production of certain antibiotics, and other processes of present-day industrial microbiology are the results of the work of such men as Schwann, Mitscherlich, Pasteur, and Buchner. The proponents of the chemical theory of fermentation should also receive some credit because their criticisms stimulated further and more careful work by the holders of the biological theory.

DISEASE

The student of history is acquainted with the fact that epidemics and plagues are as ancient as written records. The idea of contagion is an old one, as Biblical references indicate, but the cause of disease was generally believed the result of action of supernatural agencies. This belief gave way to the conviction that natural causes such as comets, floods, earthquakes, and air changes gave rise to epidemics. Some men thought, however, that disease could be contracted by touch and that the agent or principle was in the clothing. Francastoro (1483-1553) explained contagion by suggesting the existence of seeds of infection which could be passed from one person to another. He also described epidemics that occurred in his time and apparently recognized the immune state that exists after attacks of measles and smallpox.

The ideas of Francastoro and others who supported the contagion theory were lost, and it was not until Leeuwenhoek's discovery of the bacteria that the old belief that certain diseases might be caused by invisible living agents was revived. Martin in 1720 expressed views on the cause of consumption that approximated today's facts. Plenciz, who in 1762 discussed the transmission of diseases by contacts, fomites, and through the air, stated that he believed in the doctrine of contagion and that there was specificity to the living causes of diseases. He had no experimental proof, but his ideas were basically sound. In spite of the theorizing of Martin, Plenciz and others, and of the recognition of bacteria on every hand, the actual demonstration of a microscopic living agent as a cause of disease was not accomplished until the first third of the nineteenth century.

Bassi (1835) was not a scientist but a lawyer, plagued by poverty and ill health, yet he demonstrated that a disease of silk worms was due to a parasitic fungus. He demonstrated its transmissibility by taking subdermal tissue from diseased worms that had been passed through a flame and producing the disease in healthy worms by introducing the diseased tissue. This work was confirmed by others, and Vittadini (1852) cultivated the fungus on various media. Bassi, because of his poor health, had to stop experimentation but continued to develop his theory of contagion. Other work followed such as that of Donne', who in 1837 found spirochetes and bacteria in the secretions of the genital tracts of men and women. Such observations led to the microscopic examination of many products derived from the sick; and fungi, yeast, and molds from many sources were recorded. At about this time a cholera epidemic appeared, and, although microscopic examinations were made, the specific agent was apparently not recognized. Snow in 1849, however, accurately related the disease to the water supply, and later (1854) his views gained ground when he traced an outbreak to a specific pump where he found evidence of contamination. The fungus theory of

the cause of disease gained little headway, but considerable information was acquired about their growth and life-cycles. The alternation in the generations of fungi observed led to the conclusion that bacteria also exhibited the same pleomorphism.

During the middle and latter part of the nineteenth century the bacterial cause of certain diseases was recognized. Rayer (1850) reported the observation of microscopic bodies in a sheep dead from anthrax, although Davaine probably first saw them. Pollender described the same bodies and found them also in the spleen in great abundance. Brauell, in 1857 and 1858, confirmed these findings, and, through a series of inoculations with anthrax blood, was able to carry the disease serially from man to sheep, to horse, to horse. Davaine in further studies confirmed its transmissibility and also demonstrated that only minute amounts of blood were needed for transmission. This work supported the germ theory, but it was opposed by some who considered the bacteria observed to be stages in the life cycles of fungi.

Koch, a German physician, announced to Cohn in 1876 that he had discovered the life cycle of anthrax. Koch demonstrated that the anthrax bacilli grew to filaments and that bodies formed inside the filaments, which he recognized as spores, and that the spores would again grow into rods. He was able to transmit anthrax with uniformity through generations of mice. Koch also showed that anthrax was different from other diseases and concluded that only one kind of organism could cause it and that others, if pathogenic, would act in a different manner. Pasteur became interested in anthrox, and bacterial research at this time took two directions: Koch took the one of bacterial isolation, cultivation, and improvements of techniques; Pasteur and his colleagues pursued the study of ways in which infectious diseases are produced and mechanisms of recovery.

Koch's work resulted in the improvement of techniques of staining and cultivation, and, as he improved methods, fundamental advances were the result. He made many discoveries, but none that attracted more attention than the discovery of the tubercle bacillus. At the reporting of this discovery he also announced his postulates that have influenced bacteriological research to this day.

In the years that followed Koch's work on anthrax, the results of many investigations were reported very rapidly. The germ-theory was firmly established, etiological discoveries were being made in all countries, and great technical advances were made. Filtration of bacterial suspensions was introduced so that filtrates, free from organisms, could be tested for toxicity. The failure of paper, porous clay, and asbestos to retain bacteria lead Chamberland in 1884 to make a bacteria-retaining filter of unglazed porcelain. Other filters appeared, but soon unexpected results were obtained. Iwanowski in 1890 showed that the ultramicro-

scopic agent of tobacco mosaic was present in the filtered juice of diseased leaves. This was confirmed by Beijerinch, and a few years later the cause of foot and mouth disease was shown also to be a filterable agent. These findings opened new vistas in the field of infectious agents responsible for disease; the field of virology in which many fascinating discoveries have appeared and which now is considered by many as independent.

Bacteriology has another offspring, immunology, which, like its parent, has an interesting history. Jenner in 1798 reported the results of his studies of the immunity to smallpox shown by milk maids who had been infected with cowpox and established the principle of active immunization against this disease even before its etiological agent was known. Pasteur, around 1877, found that chickens inoculated with old cultures of the organism of fowl cholera recovered after a mild illness. He immediately recognized the relation of his work to immunity against smallpox and gave the name vaccine to the various altered or attenuated organisms used to immunize against many bacterial diseases. Smith and Salmon between 1884 and 1886 showed that it was possible to produce immunity with killed organisms, thus avoiding the dangers of living, attenuated organisms. Pasteur's continued work resulted in the development of his well-known treatment for persons exposed to rabies.

Two ideas of the basis of immunity developed. One held that the protection was due to the action of the blood and tissue fluids, while the other regarded certain cells as the means of defense against infection. Both doctrines contained much truth, but this initial controversy gave birth to the sciences of immunology and serology, which, although closely allied to bacteriology, are perhaps better classified as subdivisions in the sciences of biochemistry and physiology.

Scientists' innate desire to investigate the things that interest them led to the discovery of the causes of many specific diseases. In addition to satisfying academic curiosity, bacteriological discoveries concerning infectious disease agents have been of inestimable benefit to man. The systematic approach in the formulation of ideas, in the scientific testing of ideas, and the critical review of the results by the workers themselves and those who opposed their theories led to unbelievable progress. Present-day bacteriology is simply an extension of the principles established by Pasteur, Koch, and others. To attempt to measure all the influence that these men had on the growth of bacteriology and methods of research is as impossible as to cite all the benefits that mankind has derived from their work.

CLASSIFICATION

The early microscopists made little or no attempt to classify the animalcules that were found by Leeuwenhoek and Joblot. Linne' in his work grouped them under the term "Vermes" and in a class which he

called 'chaos'. One species of the latter was 'infusoria'. Muller made the first attempt to classify the infusoria, which he divided into two genera, *Monas* and *Vibrio*. Ehrenberg expanded and altered Muller's classification and included 22 families, only three of which are considered of bacteriological interest.

Cohn, a botanist, in a publication (1854) suggested that Ehrenberg's Vibrionia family, because it resembled algae more than it resembled members of the animal kingdom, should be put in the vegetable kingdom. Cohn believed that bacteria could be classified in genera and species because his studies revealed a constancy in form in spite of environmental differences. He pointed out, however, that classification on a morphological basis was not enough, since similar forms may vary in physiological activities. The acuteness and correctness of this observation is well recognized by the modern bacteriologist. Cohn studied all the known bacteria of his time and conducted, in addition, experiments on bacterial metabolism.

The pleomorphic theory of bacteria was hard to dispose of, and many opposed Cohn's views that the bacteria formed a compact group. The doctrine of the constancy of morphological form was challenged, and experiments were designed to show that each bacterium existed in several morphological and physiological forms. Buchner (1882), for example, reported the changing of *B. subtilis* to *B. anthracis* by shaking the organisms at various temperatures. Cohn, in answering the criticisms, extended his investigations and his enormous accomplishments did much to bring order out of the confusion.

Classification is a continuous process and even today there is no system that is complete or entirely acceptable. The excellent work of the early men, however, furnished the basis and as a result of their efforts bacteriology emerged as a definite science.

ADDENDUM

No attempt has been made in this account to recognize more than a few of the men and a part of the work that contributed to the founding and development of bacteriology as a science. Those intimately familiar with the field will recognize the omission of important men and findings. Instead I have endeavored to show the general trends of development through the work of characteristic figures. From its early, tentative experimentation, we have seen develop a systematic approach to bacteriological problems, superior in its planning, critical in its analysis, and constantly improving in its techniques, but always based firmly on principles established by the giants in the field. To the reader the figures of the great explorers are plain and the importance—not only to their own, but to other sciences and to himself—of their discoveries is apparent.

In a paper of this nature it is possible to examine but a few, if any,

of the original papers and reliance must be placed on the extensive writings of others. To these authors we give due credit, and for those readers who may wish to examine the material used or who desire further reading these references are cited.

REFERENCES

BIRKELAND, J. 1942—Microbiology and Man. *F. S. Crofts and Co.*, New York.

BULLOCH, WILLIAM. 1930—History of Bacteriology. *Medical Research Council.*

CASTIGLIONI, A. 1947.—A History of Medicine. *Alfred A. Knopf*, New York.

DOBELL, C. 1932—Antony van Leeuwenhoek and his "little animals." *Harcourt, Brace and Co.*, New York.

NORDENSKIOLD, ERIK. 1928—The History of Biology. *Tudor Publishing Co.*, New York.

MCCLUNG, L. S. 1944—Early American Publications Relating to Bacteriology. I. Textbooks, Monographs, Addresses, *etc. Bact. Rev.* 8, 119-160.

SHAPLEY, H. *et al.* 1946—A Treasury of Science. *Harper and Brothers*, New York.

SMITH, D. T. *et al.* 1948—Zinsser's Textbook of Bacteriology. *Appleton-Century-Crofts, Inc.*, New York.

VAN NIEL, C. B. 1949—The "Delft School" and the Rise of General Microbiology. *Bact. Rev.* 13, 161-174.

Isolation of a Virus Causing Granulosis in the Red-Banded Leaf Roller[1]

HARRIETTE BLOCK WASSER AND EDWARD A. STEINHAUS
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In December, 1949, our laboratory received for diagnosis diseased larvæ of the red-banded leaf roller, *Argyrotaenia velutinana* (Walker), from Dr. W. J. Schoene and Miss Nannie V. Sibold of the Virginia Agricultural Experiment Station at Blacksburg, Virginia. The deceased larvæ had been observed during the course of life history studies on the insect. The green or yellow-green color of healthy larvæ had become less intense in diseased individuals which usually assumed a straw-colored to whitish aspect. Microscopic examinations of the body contents of the infected insects revealed the presence of large numbers of minute granules. Such granular inclusions are characteristic of the virus diseases of insects known as "granuloses" (see Steinhaus, 1949*a*, p. 500). This diagnostic report has been included in a paper by Sibold (1950) recently published in this journal.

In July and August, 1950, more diseased larvæ were obtained from Miss Sibold. Examinations with the light microscope as well as with the electron microscope again indicated that the insects were infected with a granulosis virus. With this additional diseased material a more careful study of the virus was made, including its isolation and measurement.

Electron micrographs of the granular inclusions, after they had been separated from the fatty tissue and washed (figs. A and B), showed them to be bodies somewhat ovoid in shape and similar in their general appearance to those that have been described in other granuloses (Steinhaus, 1949*b*.) The average size of the granules was approximately 160 millimicrons wide by 315 millimicrons long.

To obtain the virus particles themselves, the granules were treated with 0.04 M Na_2CO_3 in 0.05 M NaCl for 3.5 hours at room temperature (approximately 25° C.). The material was then centrifuged in a Servall centrifuge at 10,000 rpm (11,800 g) for 1 hour, after which the sediment was taken up in water and recentrifuged in a Spinco centrifuge at 10,000 rpm. (8,998 g) for 30 minutes. The sediment was resuspended in water and this time centrifuged at 40,000 rpm (144,000 g) for 1 hour after which mounts were made for the electron microscope examination of the sediment.

The isolated virus appeared as single rods (one rod apparently enclosed within each granular inclusion body), approximately 50 by 250 millimicrons in size. Most of the rods in the preparations examined appeared to be somewhat curved, although others were straight. This curvature probably represents varying degrees of "unfolding" of the rod from the completely bent position represented by the small oval-

[1] Contribution from the Laboratory of Insect Pathology, Division of Biological Control, College of Agriculture, University of California, Berkeley.

appearing bodies seen in the same preparation (figs. C and D). Unfortunately, printed half tone reproductions do not show the bent, horseshoe effect with the clarity that it may be seen in the original photographic plates. Even though all indications are that the bent rods were in the process of unfolding, actually we have no conclusive proof that in this instance they were not in the process of folding.

The possible presence of a membrane surrounding each of the virus particles is suggested in some of the electron micrograph preparations (see fig. E). What are apparently empty membranes may also be seen. These observations, as well as those described in the preceding paragraph, to some extent confirm certain of the observations of this nature made recently by Bergold (1950).

Infectivity tests using those insect hosts (the variegated cutworm, *Peridroma margaritosa* (Haw.); the buckeye caterpillar, *Junonia coenia* Hbn.; the salt-marsh caterpillar, *Estigmene acraea* (Drury); and the omnivorous looper, *Sabulodes caberata* (Guene) in which other granulosis viruses have been found in this laboratory showed no susceptibility to the virus isolated from the red-banded leaf roller.

In accordance with proposals recently advanced (Steinhaus, 1949*b*) regarding the systematics of the insect viruses, the virus we have just described belongs to the genus *Bergoldia*. The name *Bergoldia clistorhabdion* n. sp. (Gr. *kleiostos* = enclosed + rhabdion = a little rod) is hereby proposed for it. The type strain of this virus has been deposited with the American Type Culture Collection.

REFERENCES

BERGOLD, G. H. 1950—The multiplication of insect viruses as organisms. *Canadian Jour. Res.*, 28:5-11, 1 table, 4 plates (89 figures).

SIBOLD, N. V. 1950—Gramulosis of the red-banded leaf roller. *Virginia Jour. Sci.*, 1:266.

STEINHAUS, E. A. 1949*a*—Principles of insect pathology. McGraw-Hill Book Co., Inc. New York 757 pp, 219 figures.

STEINHAUS, E. A. 1949*b*—Nomenclature and classification of insect viruses. *Bact. Revs.*, 13:203-223, 4 plates (22 figures).

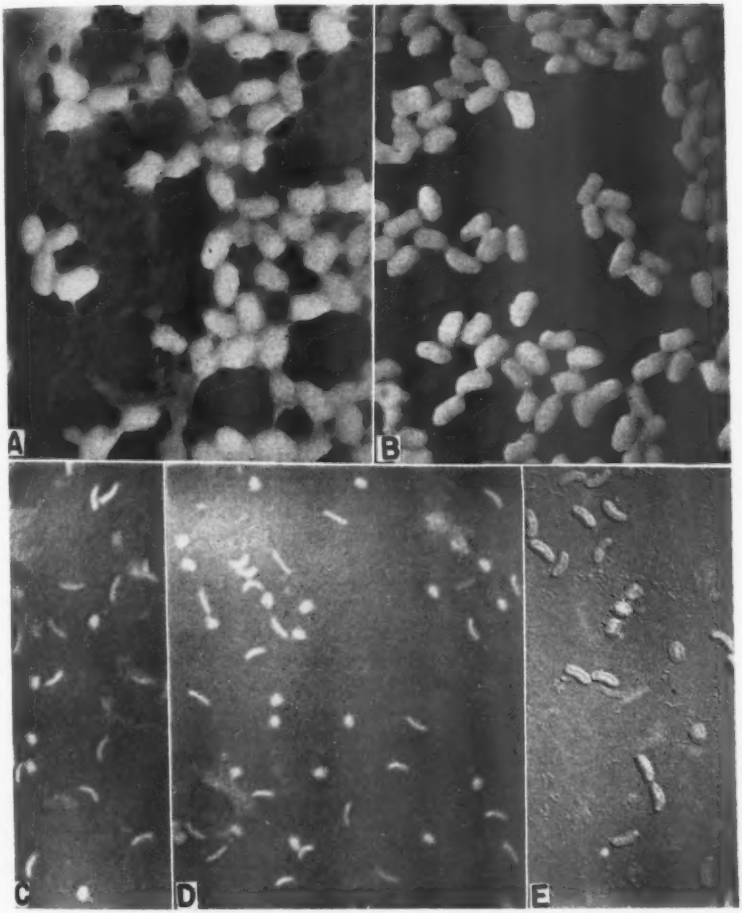
LEGENDS

PLATE I

Electron micrographs of granules and virus particles (*Bergoldia clistorhabdion* n. sp.) from infected larvæ of the red-banded leaf roller, *Argyrotaenia velutinana* (Walker). Palladium shadowed. Magnification approximately 23,000 X.

Fig. A. Granular inclusions prior to being washed free of adhering material.

Fig. B. Granular inclusions after being separated from the fatty tissue of the host and washed by repeated centrifugation in distilled water.



Figs. C. and D. Virus particles freed of granular material by treatment with sodium carbonate. Some of the forms shown represent those observed during what appears to be an "unfolding" of the isolated rods.

Fig. E. Forms suggesting the possible presence of a membrane surrounding each of the virus particles. What may be empty membranes may be seen in the upper right hand corner of the photograph and near the left of center.

Prediction of Subsonic Pressure Distributions By The Sound-Space Theory

ROBERT WESLEY TRUITT
North Carolina State College

INTRODUCTION

Analogous to the Special Theory of Relativity, a new approach to subsonic compressible flow has been introduced (Truitt, 1949) involving the relations of space and time between the compressible and incompressible planes. The theory utilizes the concept of the *sound-space* (*ibid.*) where the speed of sound plays the role of a universal constant analogous to the speed of light in the Theory of Relativity. Relativistic equations for mass, momentum, and energy of the air are found as are body contractions which are in the form of the Prandtl-Glauert contractions but are basically different. Although the expression for the body contraction is of the Prandtl-Glauert form, it is importantly different because the theory shows that there are local contractions which are a function of the *local* Mach number rather than the free-stream Mach number.

This paper is concerned with one of the simpler results of the Sound-Space Theory, namely the relations between the compressible and incompressible pressure coefficients. The concept of "local reference frames" (Truitt, 1949) enables one to calculate easily the "local" pressure coefficient on the surface of a body at any given free-stream Mach number less than the critical, provided the incompressible (M = O) pressure distribution is known. In calculating the pressure distribution for a desired free-stream Mach number, there cannot be any point where the local Mach number of unity has been reached since the expression for the local compressible pressure coefficient is undefined at that point.

The Prandtl-Glauert and the Karman-Tsien (Liepmann, *et al*, 1947) relations between the compressible and incompressible pressure coefficients have been used to calculate the compressibility effects for given free-stream Mach numbers for an NACA airfoil for which reliable experimental pressure distributions were known. These calculated results have been plotted along with those predicted by the Sound-Space Theory and it appears that the latter predicts the experimental pressure distribution with greater accuracy.

The simplicity of the Sound-Space calculations in predicting the pressure distribution over a body and the closer agreement with experi-

ment, particularly over the nose of the airfoil and especially over the entire lower surface, make this method of solution highly desirable.

NOTATIONS

M = free stream Mach number
M_l = local Sound-space Mach number
V = velocity of the free-stream
c = speed of sound
p = static pressure in the free-stream
p_l = local static pressure (as at airfoil surface)
P = pressure coefficient, $p - p_l / q$ (the ordinate of the pressure distribution diagram)
ds = straight-line segment of a body surface in direction of flow (unit thickness spanwise)
F_n = normal pressure force
q = dynamic pressure
t = time

SUBSCRIPTS

comp = compressible
i = incompressible
l = local

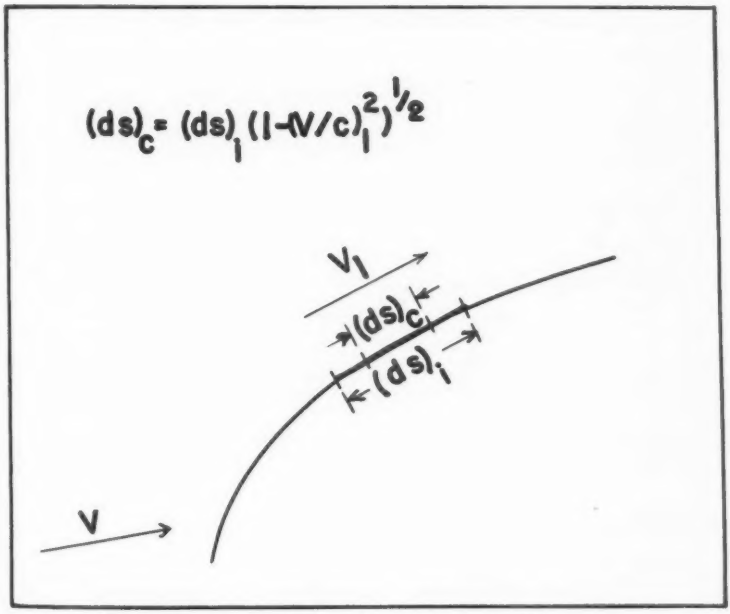


FIGURE 1. Local Contractions of Surface Elements.

THEORETICAL CONSIDERATIONS

Preliminary results of the Sound-Space Theory (Truitt, 1949) show that the apparent contraction of a straight-line portion (local reference frame) of a surface in a steady flow is of the magnitude (Fig. I)

$$(1) \quad (ds)_{comp} = (ds)_i \sqrt{1 - (V/c)_i^2}$$

The time relations between the compressible and incompressible plane are also found in the form:

$$(2) \quad (t)_{comp} = (t)_i \sqrt{1 - (V/c)_i^2}$$

These relations of space and time between the compressible and incompressible planes are then used in the same manner as in the Special Theory of Relativity (Synge, *et al*, 1942) to find the relations of mass density of the air:

$$(3) \quad P_{comp} = \frac{P_i}{\sqrt{1 - (V/c)_i^2}}$$

This expression reveals that the apparent mass in the compressible case is multiplied by the factor $\left[1 - V/c)_i^2\right]^{-1/2}$ It should be noted that this means that over a body, such as an airfoil, where the local Sound-space Mach number, $(V/c)_i$ is different for different points along the surface, the magnitude of the apparent density is different. Obviously, the apparent contraction of a surface element as expressed in (1) is likewise a function of local Mach number. This is the essential and important difference in the results of the Sound-Space as compared to the Prandtl-Glauert relations with respect to contractions. It should be noted that Eq. (3) is new since only by using the relativistic Eqs. (1) and (2) could this relation between the compressible and incompressible planes be derived.

The local density relation (3) can now be used to find the relation between the pressure forces on an infinitesimal surface element, ds, for a compressible and an incompressible fluid. For the same fluid element, ds, and the velocity over this element the same in both the compressible and incompressible case, the pressure forces have, according to (3), the relation

$$(4) \quad (dF_n)_{comp} = \frac{(dF_n)_i}{\sqrt{\left[1 - (V/c)_i^2\right]^3}}$$

This means that the pressure force on an elemental surface is proportional to the dynamic pressure and, since the velocities are the same for both cases, the relation between pressure forces is not the same as for the density relations.

The local pressure forces are, of course, directly proportional to the local pressure coefficients corresponding to the compressible and incompressible case and therefore, the pressure coefficient relation may be written as

$$(5) \quad (P_{comp})_1 = \frac{(P_i)_1}{\sqrt{1 - (V/c)_1^2}}$$

The relation (5) then becomes the simple tool with which the pressure

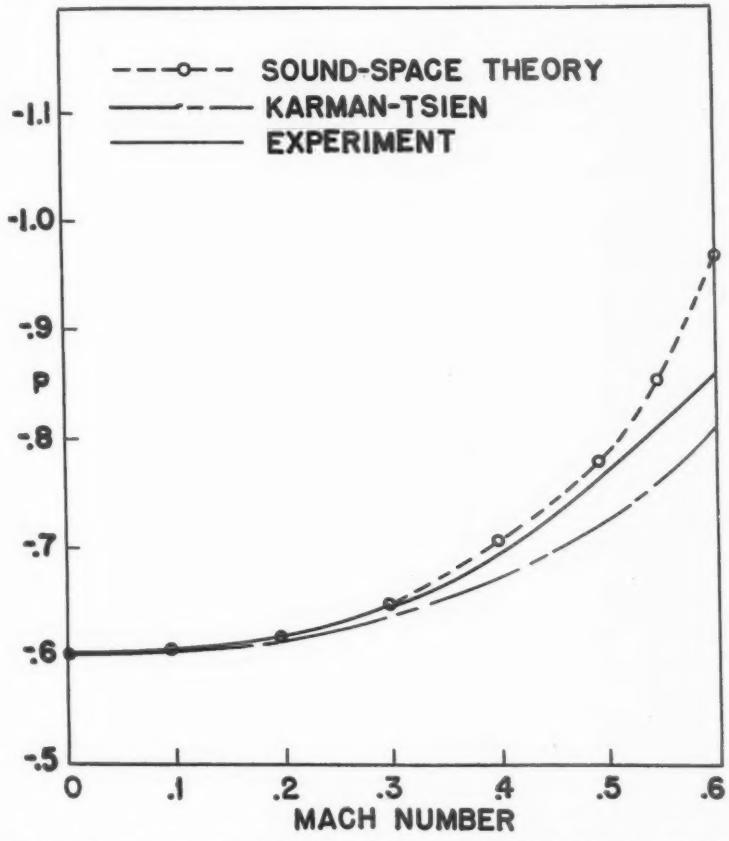


FIGURE 2. Pressure Coefficient vs. Free-Stream Mach Number NACA 4412 Airfoil, P @ 30% Chord, Upper Surface, $a = -2°$.

distribution for a given free stream Mach number (below the critical Mach number) can be calculated.

A question may arise at this point as to why the density relations were used instead of the contraction Eq. (1) as is done in the classical solution of Glauert (1927). Actually the result (4) could not have been derived by the classical methods. The Sound-Space results (4) and (5) are not only new but the density relations allow a more straightforward solution. The reason for this is that the apparent contractions are merely a step to deriving the more significant relations of mass density.

INCOMPRESSIBLE PRESSURE DISTRIBUTION

To calculate the pressure distribution for a given free stream Mach number, using Eq. (5), it is necessary to have the experimental pressure distribution for a free stream Mach number as near to zero as possible.

METHOD OF PREDICTING COMPRESSIBLE PRESSURE DISTRIBUTION

The method of calculating the desired pressure distribution over a body is given in step form as follows:

(1) Calculate the maximum local Mach number on the surface of the body from the low-speed experimental pressure distribution to ascertain that no appreciable compressibility effects are present. A maximum local Mach number less than 0.2 is considered satisfactory. The value of the local Mach number can be obtained from the equation

$$(6) \quad (P_i)_i = \frac{2}{\gamma M^2}\left[\frac{\left(1 + \frac{\gamma - 1}{2}M^2\right)^{\gamma/\gamma - 1}}{\left(1 + \frac{\gamma - 1}{2}M_i^2\right) - 1}\right]$$

(2) Choose the free stream Mach number, less than the critical, for which the pressure distribution is desired and set up Eq. (6). For example, suppose the pressure distribution is to be calculated for a free stream Mach number of $M = 0.534$. Then the Eq. (6) is

$$(7) \quad M_i^2 = 5\left[\frac{1.057}{(0.1995\ (P_i)_i + 1)^{0.286}} - 1\right]$$

Pick off successive values of the local low-speed pressure coefficients, $(P_i)_i$ over the upper and lower surfaces of the body at sufficiently close intervals to allow a smooth plot and calculate the local Sound-Space Mach number squared, $(V/c)^2_i$.

(3) Calculate the corresponding local compressible pressure coefficients by substituting the values of the local incompressible (low-speed) pressure coefficients together with the corresponding local Sound-Space Mach number squared into Eq. (5).

(4) In calculating a sufficiently large number of points over the surface of the body, particularly over the nose-section, a better defined pressure distribution can be plotted and any irregularities can be quickly identified as probable calculation errors.

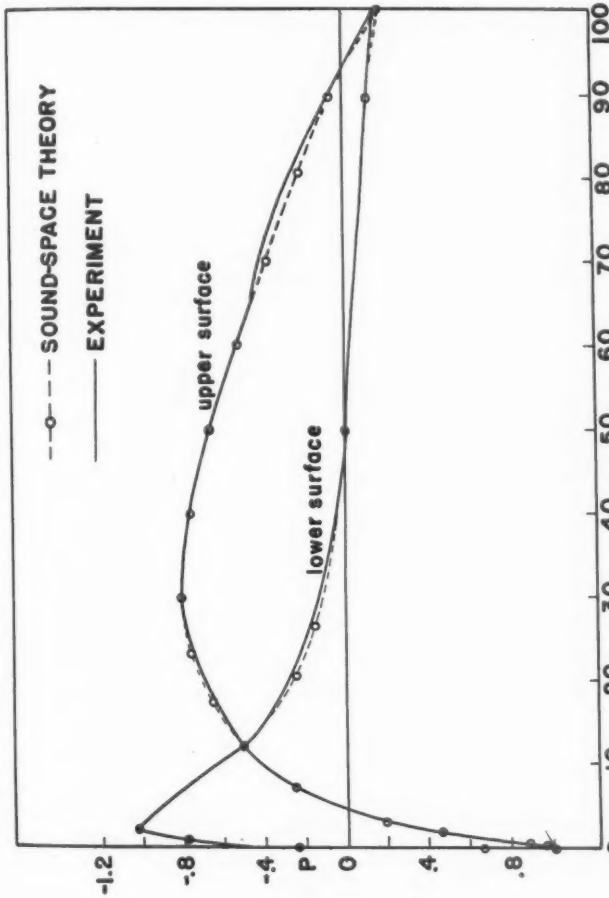


FIGURE 3. Comparison of Sound-Space Theory with Experimental Pressure Distribution for NACA 4412, $\alpha = -2°$, Free Stream Mach Number = 0.498.

DISCUSSION

An inspection of Fig. II reveals the accuracy of the Sound-Space method outlined above in predicting the maximum negative pressure co-

efficient of the NACA 4412 airfoil at -2° angle of attack. The theory predicts exactly the experimental results up to a free-stream Mach number of 0.3 For higher free-stream Mach numbers the Sound-Space Theory predicts slightly higher maximum negative pressure coefficients than the experimental values show. This is to be expected since the theory assumes steady flow throughout and in reality there were local shock disturbances as the critical free-stream Mach number was approached.

In general the theory appears to predict closer to the experimental values for incompressible pressure coefficients that are relatively large. It is believed that this is the reason for the excellent agreement with experiment over the nose-section of the airfoil where the local pressure coefficients are large even for the incompressible case.

A complete pressure distribution for the NACA 4412 airfoil has been calculated for a free-stream Mach number of .498 by the Sound-Space method as outlined above (Fig. III). The low-speed experimental data, from which these pressure distributions were calculated was for a free-stream Mach number of 0.1. An examination of the calculated pressure distribution for a free-stream Mach number of 0.498, Fig. III, shows almost complete agreement with the experimental values. The Calculated values disagree slightly for both the upper and lower surface in the region from 15 percent to 30 percent chord positions. For free-stream Mach numbers of 0.534, and 0.603, the calculated values in this region appear to overestimate the effects of compressibility on the upper surface and underestimate them on the lower. In both cases, however, there is considerably better agreement with experiment for the Sound-Space Theory than for other methods.

CONCLUSIONS

It is of utmost importance to note that the Sound-Space approach to subsonic compressibility effects is an exact solution to the problem of calculating the subsonic pressure distribution. The Eq. (5) was derived on the basis of relativity principles, and nowhere in the analysis was it necessary to make any simplifying assumptions such as small perturbations, etc.

The validity of the physical principles upon which the Sound-Space Theory was founded and the consequent exact solution to the problem of subsonic compressibility effects should signify an important advance to the better understanding of compressible fluid phenomena.

REFERENCES

GLAUERT, H. 1927—The effect of compressibility on the lift of airfoils. *Proc. Royal Soc.*, 118:113.

LIEPMANN, H. W. AND A. E. PUCKETT 1947—Introduction to aero-

dynamics of a compressible fluid. *John Wiley and Sons, Inc.*, New York, pp. 172-185.

STACK, JOHN, W. F. LINDSEY, *and* R. E. LITTELL 1938—The coml pressibility burble and the effect of compressibility on pressures and forces acting on an airfoil. *NACA Report*, No. 646:16-17.

SYNGE, J. L. AND B. A. GRIFFITH 1942—Principles of mechanics. *McGraw-Hill Book Co., Inc.*, New York, pp. 468-481.

TRUITT, R. W. 1949—Analogy of the special theory of relativity to the study of compressible fluid flow. *Department of Experimental Engineering, North Carolina State College, Bull.* No. 44.

GASTROPHYRNE CAROLINENSIS CAROLINENSIS (HOLBROOK) IN SOUTHWESTERN VIRGINIA.—Bailey (Copeia, 1936, no. 2, p. 115), in reporting *Gastrophyrne c. carolinensis* in northeastern Tennessee, suggested that the species should be found also in southwestern Virginia. On June 21, 1950, while driving between Jonesville and Cumberland Gap, Lee County, Virginia, we heard the unmistakable calls of this frog in ponds adjacent to the road (U. S. Hy. 58) 4.5 miles west of Jonesville. A search for calling individuals was unsuccessful, but a series of fifteen specimens was secured by turning slabs of limestone near the edge of one of the ponds. The locality at which the collection was made is in the valley of the Powell River in the upper Tennessee drainage basin. The ponds occupied sinkhole depressions in treeless, grassy pastureland, with several limestone outcrops forming small ledges. It had been raining during the day that these specimens were collected, and also the previous day. In driving north from Elizabethton, Tennessee, we had heard *Gastrophyrne* near Bluff City—one of the localities reported by Bailey.

Although *G. c. carolinensis* is known to occur in the Coastal Plain and lower Piedmont in Virginia, our Lee County locality constitutes the first record for this species in the Great Valley in the southwestern part of the State. *Gastrophyrne* is still to be looked for in Scott and Washington counties, both of which are geographically and altitudinally closer to the Tennessee localities than is central Lee County.—JAMES A. FOWLER, *Academy of Natural Sciences, Philadelphia, Pa.*, and RICHARD L. HOFFMAN, *Clifton Forge, Va.*

The Life History of *Gerris Canaliculatus* Say In Virginia (Hemiptera:Gerridae)[1]

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The members of the family Gerridæ, or "waterstriders," are among the most familiar inhabitants of our ponds and pools, but the life histories of only a few of the species have been studied. When these studies on *Gerris canaliculatus* (Say, 1832) were made, no published data were available on the life history of this species, but recently Penn and Goldsmith (1950) have published a brief account of the cycle of *canaliculatus* in Louisiana. No mention was made, however, of the number of generations per year although they stated that the life cycle from egg to emergence of the adults averaged 28.9 days. This would allow time for four or five generations per year, whereas, in Virginia, there are but three.

Penn and Goldsmith stated that the eggs of *canaliculatus* "were considerably smaller than those described for other species," but my measurements of the eggs of *canaliculatus, marginatus,* and *insperatus* were almost identical. The measurements given by Bueno (1917) for eggs of *marginatus* were undoubtedly in error and should have been 1.0 mm. long and 0.3 mm. wide instead of 1 mm. by 3 mm.

Distribution.—This species is widely distributed, having been recorded from Rhode Island, Connecticut, Massachusetts, New York, New Jersey, Virginia (Kuitert 1942), North Carolina, Georgia, Florida, Louisiana, Mississippi, Alabama, Texas, Arkansas, Indiana, Iowa, and Ohio. In addition, specimens from South Carolina are in the Clemson College Museum.

I have a total of 168 adults and 196 nymphs of *Gerris canaliculatus* in my collection from Virginia. These specimens were collected from the following localities:

Albemarle Co.—"Old Reservoir" at University of Virginia, "Old Fish Hatchery" 1.3 miles south of Charlottesville on U. S. Hwy. 29, and Miller School reservoir near Batesville; *Alleghany Co.*—7.0 miles east of Clifton Forge on U. S. Hwy. 60 (R. L. Hoffman); *Appomattox Co.*—Oxford Furnace Wayside on U. S. Hwy. 460 east of Appomattox; *Charles City Co.*—1.0 miles east of

1 Contribution from the Miller School of Biology, University of Virginia.

Providence Forge on St. Hwy. 155; *Chesterfield Co.*—4.1 miles from University of Richmond on James River Road; *Dinwiddie Co.*—14.7 miles south of Petersburg on U. S. Hwy. 1; *Gloucester Co.*—9.1 miles north of Gloucester Point ferry landing on U. S. Hwy. 17; *Isle of Wight Co.*—2.8 miles east of Franklin on U. S. Hwy. 58; *Nelson Co.*—Rockfish River at intersection of U. S. Hwy. 29 and St. Hwy. 151; *Norfolk Co.*—4.4 miles south of intersection of U. S. Hwys. 13 and 17; *Southampton Co.*—3.8 miles east of Courtland on U. S. Hwy. 58.

Habitat.—This species has been collected most frequently from ponds, but occasionally from swamps, roadside ditches, sluggish streams, and stagnant pools. *Gerris canaliculatus* is found on the surface of the water among the vegetation near the shores, or in the shade of overhanging branches of trees along the banks. When disturbed it quickly moves out into the deeper parts of the pond, but not being content to remain there it soon returns to the shallower waters near the banks. Members of this species are never found in large "schools," and rarely may they be taken in large numbers at any one locality.

Life History.—Eleven specimens of *Gerris canaliculatus* have been reared from egg to adult in an aquarium ($2\frac{1}{2}$ x 1 x 1 ft.) with considerable difficulty. The adults are difficult to keep in captivity since upon being distributed they dash madly against the sides of the aquarium in an effort to escape, and thus become water-logged and drown. Adults have not been kept more than a week, but nymphs, especially the younger ones, are not so excitable and have been reared in small num-

TABLE 1.—Summary of life history data on *Gerris canaliculatus* Say at Charlottesville, Virginia in 1948.

Individual Number	Length of egg stage and nymphal instars in days						
	Egg	First	Second	Third	Fourth	Fifth	Total
1	11	7	6	7	7	8	46
2	13	6	7	6	8	10	50
3	12	6	5	6	6	7	42
4	11	6	5	4	5	9	40
5	10	6	6	7	7	9	45
6	8	7	6	7	7	10	45
7	11	5	6	8	7	10	47
8	10	6	5	6	8	9	44
9	13	6	6	5	6	9	45
10	12	5	7	6	6	9	45
11	11	6	6	5	7	11	46
Average	11.1	6.1	5.9	6.1	6.7	9.2	45

bers. A summary of the life history data on the eleven specimens is given in Table 1.

Egg.—Cylindrical, posterior end abruptly tapered, anterior end flattened with micropyle. Pearly white in color when first deposited, gradually darkening as the embryo develops. Chorin covered with hexagonal areas. Length 1.0 mm., width 0.3 mm. (fig. 1). The animals kept in an aquarium fastened their eggs to cattail stems with a colorless substance; however, in nature eggs have been found on other types of aquatic vegetation. The egg stage lasts from 8 to 13 days and averages 11.1 days.

First instar.—Body oval, widest across mesothorax, pointed caudally. Antennae, legs, head, two oval areas on pronotum and two oblong areas on meso-metathorax brown; remainder of body yellowish-white. Abdominal segments marked with narrow lines of brown each side of median longitudinal line. Antennae filiform, segment 1 slightly shorter than 2 and 3 united, 4 subequal to other three united. Legs stout; tibia of front and middle legs longer than femur, shorter in hind pair; tarsi of front legs short, stout; that of middle and hind legs long, slender. Tarsi one-segmented, claws anteapical. Rostrum stout, tapering, four-segmented; joints 1 and 2 subequal, 3 longest. Length 1.6 mm., width 0:7 mm. (fig. 8). The first instar lasts from 5 to 7 days and averages 6.1 days.

Second instar.—Body more elongate. General dorsal coloration reddish-brown, venter yellowish-white. Very narrow pale median line on thorax and first few abdominal segments (a characteristic peculiar only to nymphs of this species). Antennal segment 4 slightly shorter than other three united, 2 shortest. Tibia of front and middle legs subequal to femur, but tibia only one-third as long as femur of hind legs. Legs longer and slenderer than in first instar. Tarsi one-segmented. Length

TABLE 2.—Seasonal data on field collected individuals, mainly from the "Old Reservoir" at the University of Virginia.

Stage	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Adult male (apterous)			2	3	5	8	4	7	5	8	5	
Adult male (macropterous)				3	1			3		17		1
Adult female (apterous)	1	1	3	3	15	5	20	8	6	2		
Adult female (macropterous)			2	1		1		2	6	17		3
First instar				1		1	3		1			
Second instar					2	4	3	4	5		1	
Third instar					2	6	4	7	11	3	1	
Fourth instar					1	16	7	21	9	9		
Fifth instar				1	16	4	27	12	14			

2.9 mm., width 0.9 mm. (fig. 6). The second instar lasts from 5 to 7 days and averages 5.9 days.

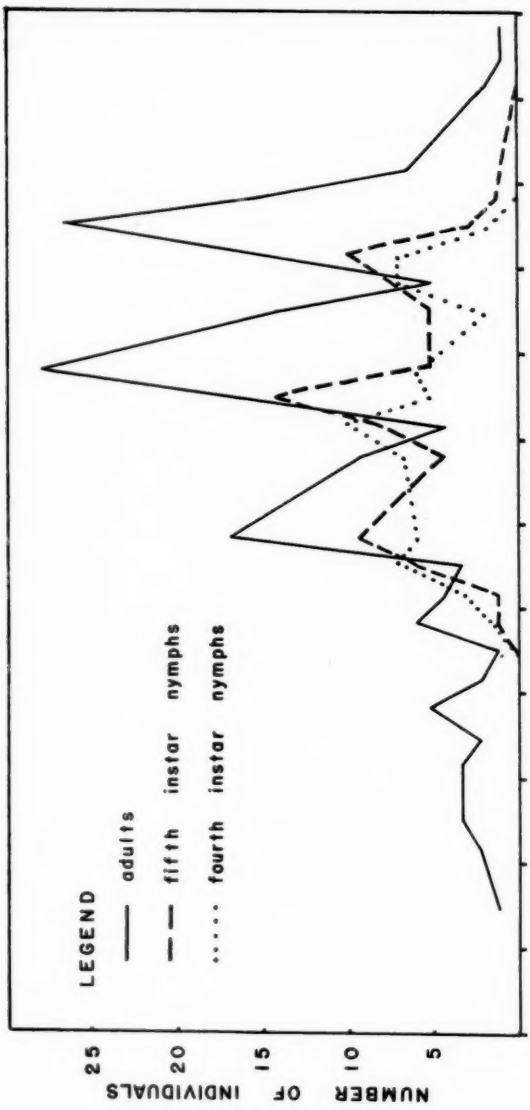
Third instar.—Body much more elongate in proportion to width. Eyes large, reniform, black. Coloration similar to that of second instar, but dark wing pads begin to appear in macropterous form. Narrow pale dorso-median line extending from vertex to posterior margin of seventh abdominal segment. Abdomen with the two genital segments distinct. Antennal segment 4 as long as 1 and 2 united, 2 and 3 subequal. Femur longer than tibia in all legs. Tarsi remain one-segmented; rostrum four-segmented. Length 4.8 mm., width 1.2 mm. (fig. 3). The third instar lasts from 4 to 8 days and averages 6.1 days.

Fourth instar.—Body continues to elongate. Brownish-black wing pads extend onto second abdominal segment. Narrow dorsal pale line as in third instar. Antennal segment 4 as long as 2 and 3 united, 2 and 3 subequal, 1 one-third shorter than 4. Tibia and femur of front legs subequal; femur longer in middle and hind legs. Other characters as in other instars. Length 6.1 mm. width 1.4 mm. (fig. 5). The fourth instar lasts from 4 to 8 days and averages 6.7 days.

Fifth instar.—The wing pads increase only slightly in length, extending onto third abdominal segment. Dorsomedian pale line as before but slightly wider. Antennal segment 4 slightly shorter than 2 and 3 united, longer than 1; 2 and 3 subequal. Legs long and slender, tibia and femur as in fourth instar. Tarsi remain one-segmented. Rostrum still four-segmened, segment 3 very long, 4 short and pointed. Length 8.6 mm., width 1.9 mm. (fig. 7). The fifth instar lasts from 7 to 11 days and averages 9.2 days.

Adult.—Body slender, elongated; color varying from reddish-brown to brownish-black. Pronotum extending over mesonotum in apterous form, with median longitudinal carina in both apterous and macropterous individuals; anterior lobe of pronotum with brownish-red median line; anterolateral stripe not reaching cephalic margin. Antennae brownish, segment 1 shorter than 2 and 3 united, 2 slightly longer than 3, 4 subequal to 1 in length. Legs brown, long and slender. Tarsi two-segmented. Caudoventral margin of sixth abdominal segment of male broadly rounded, without a median notch. Connexival spines long, slender, reaching to tip of first genital segment (figs. 2 and 4). Length 8.5 mm. to 11.6 mm.

The total life cycle from egg to adult in aquarium studies ranged from 40 to 50 days and averaged 45.1 days. The monthly seasonal data presented in Table 2 on field collected specimens seem to indicate that breeding is continuous from May through September with no significant distinct broods. However, when the monthly totals are divided into ten-day intervals and plotted, there is an indication that there are three generations per year, text figure 1. It can be seen that during the first generation no collections were made during the first two ten-day periods



TEXT FIGURE 1.—Graph showing collection data for *Gerris calaliculatus* Say.

in July and thus the peak for the first brood is shown earlier than actually it should be. The data given on the graph indicate that approximately 50 days is required to complete a generation. This closely approximates the development period from egg to adult in aquarium studies.

Dissestion of numerous adult females of several species of *Gerris* during the spring and summer indicated that *Gerris canaliculatus* was considerably less prolific than *marginatus* and *insperatus*. The ovaries of the latter species were usually filled with eggs but this was never true of *canaliculatus*. The dissections also showed that the over-wintering females of *canaliculatus* were spent by early June, and they probably died soon thereafter. Both apterous and macropterous forms are present. The seasonal data indicate that very few macropterous individuals are produced during the first generation but that the ratio to apterous individuals increases greatly during the third generation. The adults hibernate during the winter under logs, rocks, and other debris along the banks and ponds, and occasionally streams.

Remarks.—The nymphs of *Gerris canaliculatus* may be distinguished from those of all other species by the presence of the dorsomedian pale longitudinal line. This species has been collected in association with the following members of the family Gerridae: *G. insperatus, G. Argenticollis, G. remigis, G. conformis, Trepobates pictus, T. inermis,* and *Limnogonus hesione.*

Summary.—*Gerris canaliculatus* Say is primarily a pond species and adults may be collected during every month of the year. There are apparently three generations produced in Virginia from April to November each year. The eggs are deposited on aquatic plants and debris and hatch in from 8 to 13 days. The nymphal instars require the following periods before molting: first, 5 to 7 days; second, 5 to 7 days; third, 4 to 8 days; fourth, 4 to 8 days; fifth, 7 to 11 days. Nymphs may be distinguished from those of all other species by the presence of a dorsomedian pale longitudinal line. The majority of the adults of the first and second generations are apterous, but most of the individuals of the third generation are macropterous.

LITERATURE CITED

BUENO, J. R. DE LA TORRE, 1917. Life history and habits of the marginated water strider, *Gerris marginatus* Say. (Hem., Het.) *Ent. News* 28:295-301.

KUITERT, L. C. 1941. Gerrinae in the University of Kansas collections. *Univ. Kan. Sci. Bull.* 28(7):113-143.

PENN, G. H. AND R. M. GOLDSMITH. 1950. The life history of the southern water strider, *Gerris canaliculatus* (Hemiptera, Gerridae). *Jour. Tenn. Acad. Sci.* 25(1):76-79.

SAY, THOMAS. 1832. Descriptions of new species of Heteropterous Hemiptera of North America. 39 pp. New Harmony, Ind.

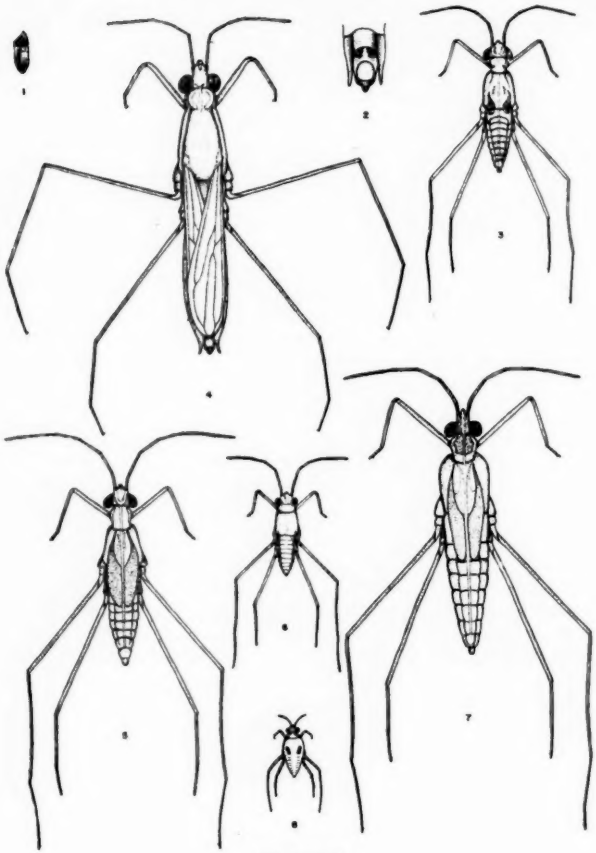


PLATE I

GERRIS CANALICULATUS SAY

Fig. 1. Egg
Fig. 2. Caudoventral abdominal segments of male.
Fig. 3. Third instar nymph.
Fig. 4. Adult female.
Fig. 5. Fourth instar nymph.
Fig. 6. Second instar nymph.
Fig. 7. Fifth instar nymph.
Fig. 8. First instar nymph.

A Report on the Effect of Ethylene Dibromide Soil Treatment on Root-Knot Control, Nodulation, and Yield of Peanuts

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The root-knot nematode causes interruption of growth, misshapen and often dwarfed pods of peanuts as has been pointed out by Steiner (1942). In order to evaluate the effectiveness of a nematocide for root-knot control, an ethylene dibromide treatment was made before planting peanuts, in 1949, to soil where peanuts had previously been known to be damaged by root-knot. It was also of interest to learn the effect on nodulation, growth, and yield of peanuts following treatments of the soil with a fumigant.

MATERIALS AND METHODS

One week before planting, the liquid nematocide, ethylene dibromide (20 percent by volume), was injected with a hand applicator along the drill row at 6-inch intervals and 5 inches deep into the soil, at the calculated rate of 25 gallons per acre. Nontreated areas were included as controls. No paper or water seal was used, although rain occurred one day after the fumigation treatment in an amount sufficient to wet the upper three inches of soil. Soil temperatures were not recorded for the period between soil treatment and planting, but the mean maximum and minimum air temperatures were 76° and 52°F. respectively. Arasan treated seed of the Jumbo Runner variety were planted on May 26, three inches apart in drill rows, 33 inches apart, and later thinned to a uniform stand. The test plots were located on Onslow fine sandy loam soil. A soil sample was collected for analysis from the test area, June 3, just prior to the application of 400 pounds per acre of an 0-12-12 fertilizer. The results of the analysis made by the Virginia Agricultural Extension Service were as follows: pH, 5.6; calcium content, fair; magnesium content, fair; organic matter, 3.4 per cent; phosphoric acid, fair; potash, fair. On July 15 gypsum was applied to the test area at the rate of 300 pounds per acre. The peanuts were dusted three times at two-week intervals, beginning July 20, with 325-mesh sulphur at the rate of 15 pounds per acre per application.

Each plot consisted of a single row, 20 feet long, with plants spaced approximately six inches apart. Yield data were obtained from only 15 feet of row, since the remaining five feet was used for examination and sampling purposes. A nontreated row was planted between each treated row. The plots were arranged in randomized blocks and replicated six times as a part of a test including several other materials evalu-

ated for nematode and fungus control. Peanuts had been planted every other year in this field for the previous ten years with an average annual yield of approximately 1600 pounds per acre. The alternate crop was either corn or corn and soybeans. Peanuts were planted in the test area in 1948. A bacterial inoculant was not applied to the seed of the 1948 crop nor to seed planted in the test in 1949.

The root-knot and nodulation scores were made and roots were collected for dry weight comparisons when the peanuts were dug on October 28. The green vines and nuts from each plot were bagged after digging and placed in a corn drier (140° F.) for 12 hours. All data were analyzed by the Department of Statistics of the Virginia Polytechnic Institute. The method of expressing nematode injury was patterned after Parris's study (1948) with *Heterodera marioni* (Cornu) Goodey on *Solanum tuberosum L.*

RESULTS

Stand counts made on June 15 and again a week later showed no significant difference due to the soil fumigation treatment. By July 24,

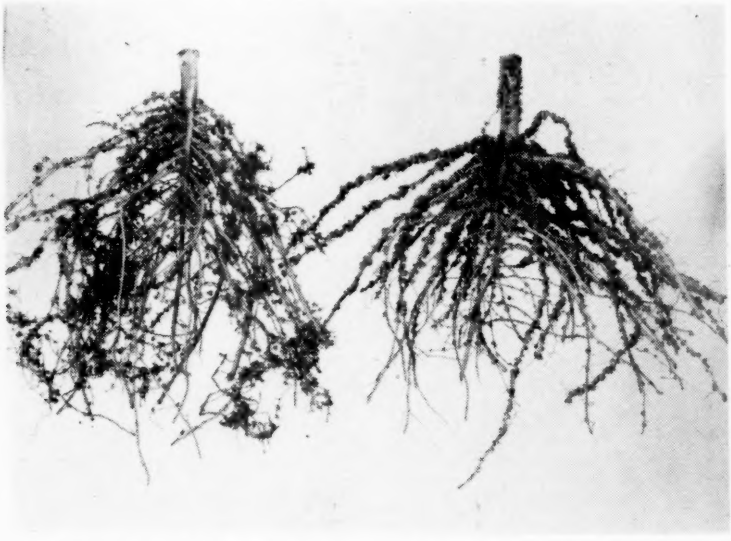

FIGURE 1.—Left: Root of a peanut plant infected with root-knot nematode from a nontreated plot. The galls are very small and generally found on lateral roots surrounded by clumps of matted rootlets. Right: Root from ethylene dibromide-treated plot. Note the heavier nodulation on tap root near crown.

fifty-one days after the seedlings emerged, a striking difference could be observed between nontreated and ethylene dibromide-treated plots. The vines on ethylene dibromide-treated plots were larger and greener in appearance. The root systems of these plants were larger and heavier, and there were more nodules on the tap roots (figure 1). Other examinations made at two-week intervals, up to the time of digging, October 28, showed that these differences in vine, root, and nodule development were consistent until the plants were dug (Table 1). Examinations made September 9 showed that there were a greater number of gynophores at the end of the lateral branches of plants grown in soil treated with ethylene dibromide. After the plants were harvested it was found that plants grown in ethylene dibromide-treated soils produced one fourth more nuts than did plants from nontreated soil (Table 1). A comparison

TABLE 1.

The effect of ethylene dibromide soil treatment on the control of root-knot nodulation, root development, and yield of drier-cured peanuts.

Treatment	Nematode severity scores[a]	Tap root nodulation scores[b]	Dry wt. of roots per plant in grams	Calculated lbs. per acre	
				Hay	Nuts
Ethylene dibromide	0.9*c	3.0*	3.33*	3920*	2200*
Nontreated (check)	2.8	1.0	1.82	2520	1820

a. Nematode severity scores: 0 = not galled, 1 = slightly galled, 2 = moderately galled, 3 = severely galled.

b. Tap root nodulation scores: 0 = no nodulation, 1 = light nodulation, 2 = medium nodulation, 3 = heavy nodulation.

a. and b. Each score value represents the sum of plants in each class times the score for that class, divided by the total number of plants.

c. Starred (*) figures indicate that values at the 5 per cent level were significantly different from the other value in the column.

of the quality of nuts from nontreated and treated plots showed no significant difference as based on the following criteria: percentage of meat, percentage of Extra Large Kernels, and number of Extra Large Kernels in a one ounce sample.

Female root-knot nematodes were found in some of the roots examined microscopically soon after the seedlings emerged; however, characteristic gall symptoms were not clearly evident until about the first week in August. The galls were very small and in most cases very difficult to see, because clumps of matted rootlets covered much of the injured portion of the root (figure 1). Later in the season it became obvious from macroscopic as well as microscopic examination that a species of the genus, *Meloidogyne* Goeldi (Chitwood, 1949) was causing injury. A summary of the relative nematode injury is tabulated in Table 1. The data were collected October 28, at the time the peanuts were dug.

Even before yields were obtained it was apparent that there was more vine growth in ethylene dibromide-treated plots than in nontreated plots. Plants were collected September 9 from nontreated and ethylene dibromide-treated plots for nitrogen analysis. The plant samples were collected and prepared as follows: One plant sample was removed from the end of each nontreated and ethylene dibromide-treated plot. The roots were washed free of soil and the plant separated into vines, roots, and pods. These respective parts were oven-dried and the samples from nontreated and ethylene dibromide-treated plots were ground, and representative samples, sufficient for analysis in duplicate, saved from each lot. These samples were then analyzed for nitrogen by the Agronomy Department of the Virginia Agricultural Experiment Station using the A. O. A. C. method. The results of the analysis expressed as per cent nitrogen of oven-dry material were as follows: nontreated plots—vines, 5.55; roots, 6.00; and kernels with testa, 6.02; ethylene dibromide-treated plots—vines, 5.48; roots, 7.00; kernels with tests, 7.64.

Although too few samples were analyzed to give sufficient data from which to draw a definite conclusion, these data suggest that the nitrogen content of the vines per unit weight was not greatly modified by the soil treatment, while that of the roots and kernels was increased. The plants in the test areas were not dug until 49 days after these samples were procured. Whether these differences in nitrogen content were maintained in mature plants was not determined.

DISCUSSION

Nodulation of peanut roots in the nontreated plots would have ordinarily been rated as fair (figure 1), yet it appeared poor, as compared to the nodulation of roots in the ethylene dibromide-treated plots. How ethylene dibromide induced better nodulation of the tap root is not known. One probable explanation is that the root-knot nematode inhibited nodulation in the nontreated plots and its control with ethylene dibromide permitted better nodulation. In this test, root-knot control, or better nodulation, or a combination of the two would seem to account for the increased plant development. It is not possible to evaluate the actual effect of the treatment until more extensive tests are conducted under controlled conditions.

LITERATURE CITED

CHITWOOD, B. G. 1949—Root-knot nematodes. Part 1. A revision of the genus *Meloidogyne* Goeldi, 1887. *Proc. Helminth. Soc. Wash.* 16:50-104, 6 fig.

PARRIS, G. K. 1948.—Influence of soil moisture on the growth of the potato plant and its infection by the root-knot nematode. *Phytopath.* 38:480-488, 3 tab.

STEINER, G. 1942.—Plant nematodes the grower should know. *Soil Sci. Soc. Fla.* 4B:117, 32 fig.

Protective Behavior and Photic Orientation in Aquatic Adult and Larval Two-Lined Salamanders, *Eurycea b. bislineata x cirrigera.*

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Two-lined salamanders occupy a broad geographic range in eastern United States and Canada. In springs, seepage areas, and small brooks from Quebec Province to northern Florida, and from the Atlantic coastal plain to Louisiana, these salamanders are abundant, rivalled in numbers in some areas by species of *Desmognathus,* but in many places the dominant species. The behavior of terrestrial adults is now well-known enough to explain why few persons see these salamanders unless they are seeking them, and know where to hunt. Terrestrial adults are "troglodytes", and live concealed from the eyes of their enemies during hours of daylight in the "caves" of their habitat,—the crevices under bark, stones, logs, and other objects lying along the margins of the waters in which they breed. The presence of adults in concealment in the field has been reported for the northern subspecies, *Eurycea b. bislineata,* by Verrill (1863), Sherwood (1895), Allen (1899), Ditmars (1905), and Bishop (1941, 1943). The basis of this troglodytic behavior was determined by Dunn (1926) as strong "negative phototropism" and a relatively weaker thigmotactic response.

When terrestrial adults are exposed in their places of concealment they make frantic efforts to escape, a behavior pattern mentioned by Allen (ibid.), and classically described by Ditmars (ibid.). Following exposure to light the salamander promptly seeks the sanctuary of darkness. This may involve locating another terrestrial refuge, but frequently involves escape into an aquatic habitat. The alarmed terrestrial adult moves primarily by means of lateral undulations rather than leg action, although frequently both methods of locomotion are used simultaneously. Upon entering an aquatic habitat the adults have been observed to seek refuge under a stone on the bottom, but nothing more on their aquatic behavior than this has been reported.

Bishop (1941) states that adults in an aquatic environment assume the habits of larvae. This may be true of feeding behavior, but observation of protective behavior fails to confirm this report. Differences between adult and larval alarm-activity patterns in aquatic habitats are pointed out in this report, and tests on the photic orientation of these animals have been made to explain dissimilarities observed. Observa-

tions and experiments have been carried out with specimens obtained from the vicinities of Williamsburg and Yorktown, Virginia. In this area, as in Gloucester, Virginia, the two-lined salamanders are intermediate in character between the northern and southern subspecies, an intergrade relationship indicated by the combined sub-specific names *bislineata x cirrigera*. Adult males in this region may be indistinguishable from typical specimens of the northern subspecies, but some individuals have the lower costal groove count of *cirrigera*, and partially developed cirri. This matter was first pointed out by Dunn (ibid.).

During part of the year these adult salamanders are found in terrestrial habitats, and in other periods the large majority of adults encountered are found living in water. The extent of the aquatic period is poorly defined. Although Noble (1931) and Dunn (*ibid.*) found adults of *E. b. bislineata* in streams in New York and Massachusetts in mid-winter, there is no direct evidence that the aquatic period is correlated with temperature. The views of Brimley (1896, 1939) that the aquatic period is correlated with the breeding season, and that the salamanders are terrestrial throughout most of the rest of the year, is substantiated by data obtained in preparing this report.

Brimley (ibid.) noted that prior to the breeding season, in December, adults are found in small rocky streams near Raleigh, North Carolina. Adults remain in those waters until the termination of the breeding period in March or April. In the Yorktown-Williamsburg areas gravid females appear in the streams in some numbers before the first males are noted. The females are first seen in late November and early December, but by the time the first egg depositions are noted, during the last week of January, the numbers of males and females in the streams are found to be approximately equal. After the termination of egg deposition in mid-April females remain with the last egg-groups through the period of four to six weeks prior to larval emergence, and again the males become scarce in the streams. Since marked specimens were not used it is not possible to state with assurance that the extent of the aquatic period of females exceeded that of the males, but it was evident that in the beginning and toward the end of the interval the bulk of adults in the waters were females.

During January, February, and March approximately equal numbers of adult males and females could be found in waters near Yorktown and Williamsburg. During hours of daylight these salamnaders remain in concealment, hidden under logs, leaf debris, or the thick loose silt layer on the stream bottoms. They may be exposed by moving these objects, and the resulting stimulation is more intense than simple light stimulation in a land habitat, since it involves tactile sensations as well lina. Adults remain in those waters until the termination of the breeding in mid-April females remain with the last egg-groups through the period as photic stimuli. The adults immediately respond to disturbance and

exposure by swimming with swift lateral undulations until they are again in concealment. Adults do not simply hide their heads under leaves and debris after an "escape" swim, but move out of sight and light quickly and completely, rarely pausing in the course of this action to rest in the open. This behavior may be explained by Noble's (1931) report that the skin of an adult salamander is light sensitive.

Adults are conspicuous in their coloration and pattern. They are marked with a broad dorsal band of lipophores ranging in hue from dull olive to brilliant yellow. Noble (ibid.) suggests that this "flash" color may conceal the animal from its enemies by diverting attention from its outline. In striking contrast with adults, the larvae are inconspicuous in color and pattern. They are marked with a melanophore system that adjusts to background color through dispersion and increase in the number of melanophores, or through aggregation and decrease. Larvae on matching backgrounds are protected from predators through their deceptive resemblance to their surroundings.

In sharp contrast to aquatic adults, larvae may be seen during daylight hours resting motionless in the open. In areas where silt and decomposed leaves cover the stream bottom the habitat is dark, and the larvae are "dark adapted." In areas where the bottom consists of sand or coquina fragments the larvae again match their backgrounds, and are "light adapted." No differences have been observed between protective behavior of "dark adapted" specimens on dark backgrounds, and of "light adapted" larvae on light backgrounds. In both cases alarmed larvae suddenly swim a few inches, and "freeze" motionless again. This behavior serves to protect the larvae from attacks of predatory mosquitofish, *Gambusia affinis holbrookii,* which inhabit the same waters and are seen rarely to strike at a non-moving target.

It takes considerable time for the larval melanophore system to adjust to a contrasting background sufficiently to materially change the hue, a fact pointed out by Sumner and Wells (1933), Sumner (1934), and Breder (1947) in the case of the *Gambusia.* Thus when larvae move from a matching background to a contrasting one, they become conspicous and their protective behavior pattern changes. This condition was first reported in the case of *Gambusia* by Breder (ibid.). The larval *Eurycea bislineata,* abandoning the "spurt and freeze" behavior characteristic of them on matching backgrounds, seek concealment, and will swim longer distances to obtain it. Unlike adults the conspicuous larvae frequently utilize partial concealment, and on contrasting backgrounds will remain in the open in deeply shaded areas.

The differences in behavior of aquatic adults and larvae appear to be paralleled by differences in photic orientation. The literature contains one reference on the photic orientation of adult *Eurycea bislineata,* and no mention is made of whether the test animals were in an aquatic or terrestrial stage. Dunn (1926) found *E. b. bislineata* to be thigmotactic

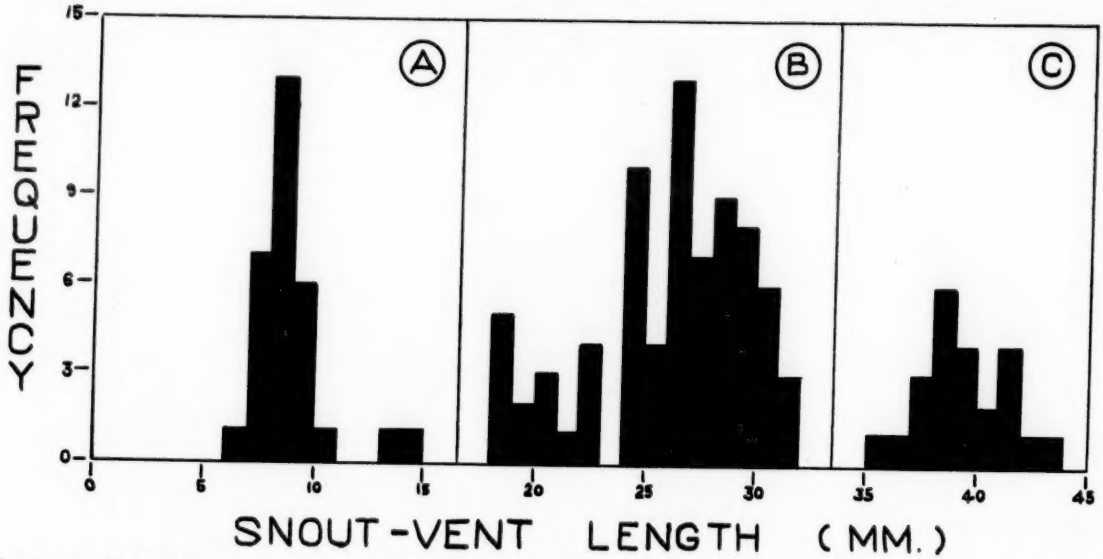

FIGURE 1. A size-frequency analysis of 127 *Eurycea bislineata* used in photic orientation tests. Group A includes 29 recently emerged larvae; group B includes 75 year-old larvae; and group C includes 23 transformed specimens.

and "negatively phototropic." When these stimuli were opposed the negative reaction to light was much stronger than the thigmotactic response. Several conditions influence responses to photic stimulations. Stier (1926) showed that the photic responses of newts may be reversed by feeding, that starved newts are negatively phototropic, while well-fed ones are indifferent or positive in response to light stimuli. Cole and Dean (1917) showed that photic responses of tadpoles change with age. Using the green frog, *Rana clamitans,* they found young tadpoles indifferent to photic stimulation, while older specimens were positively phototropic." Torelle (1903) found that photic response in two common species of frogs was influenced by temperature, that the frogs (*Rana pipiens* and *R. clamitans*) responded positively to light at "ordinary" temperatures, and negatively below 10 degrees Centigrade,—undoubtedly an important factor in hibernation.

To control some of the variables, temperatures of water in the tanks used in testing photic responses of larval and adult *Eurycea b. bislineata x cirrigera* were the same (16 degrees Centigrade), and both tanks contained brook water from the habitat where the test animals were obtained. To minimize the effects of starvation on the test animals the observations were initiated the day the salamanders were collected, and tests were completed 48 hours later. Three isolated size-groups of salamanders were obtained through non-selective collecting. Measurements of these animals are compiled in figure 1. The tiny recently emerged larvae were too small to locate in the large tank (fig. 2-B), and were tested in a shallow tank (fig. 2-A). The larger larvae and transformed specimens were tested in the large tank.

One third of the water surface in the small tank was exposed to direct illumination (150 watt lamp) which provided a maximum light intensity of 50 units (measured with a G. E. meter, type DW-58, with A.S.A. scale). Minimum light intensity in the illuminated zone was 30 units at the corners. The remaining two thirds of the tank consisted of indirectly illuminated "twilight zone." A one-half inch layer of brook sand covered the bottom of the tank evenly, and twenty-nine larvae were released for testing. Responses to visual stimuli and the motions of other larvae caused a slow but steady degree of activity in the tank. It was determined that better results would be obtained by recording the distribution of animals at well separated intervals without "reshuffling" them, since this abnormal activity might prejudice their behavior over a long period. Noble (1931) points out that "phototropism" in amphibians is overridden by responses in the field of vision. This seems to have been borne out by the activity of the test animals without outside interference. Indifference to the photic stimuli would have resulted in a random distribution of one third of the larvae in one third of the tank area, but the tests showed only 11 percent in the lighted zone. The majority of the

larvae were observed at the margin of the twilight zone, facing toward the lighted zone.

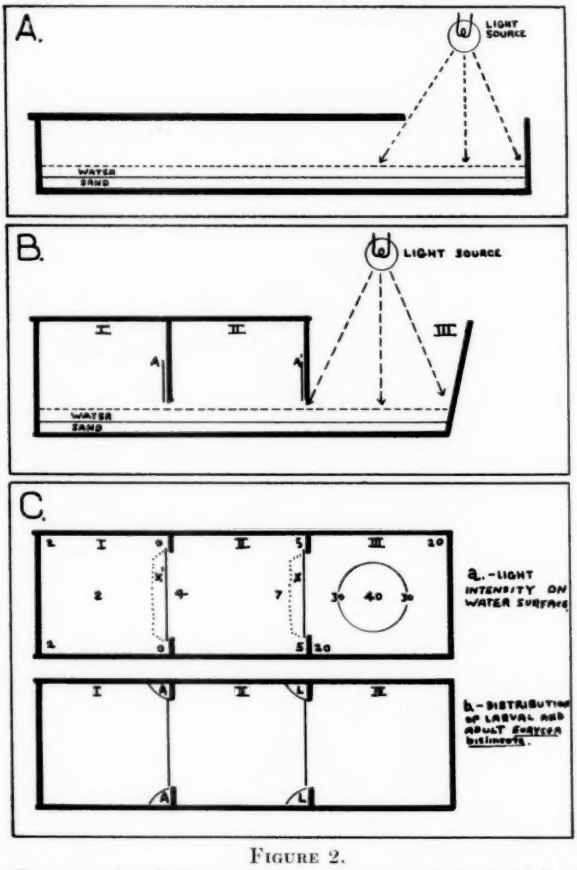

FIGURE 2.

A—Cross-sectional diagram of apparatus used to test photic orientation in recently emerged larvae.

B—Cross-sectional diagram of apparatus used to test photic orientation in year-old larvae and transformed specimens.

C (a)—Diagram of light intensity on water surface of tank (Fig. 2-B)

C (b)—Diagram of primary distribution of adults (A) and larvae (L) in tank (Fig. 2-B).

Larger larvae and adults were tested in the large tank (fig. 2-B). The light intensity pattern, determined as in the small tank, is diagrammed in fig. 2-C. The bed of the tank was evenly covered with brook sand, and as in the small tank, brook water completed the artificial habitat. Gates were designed to drop down in order to prevent an exodus of the animals during the intervals when distribution was being checked. The counts disturbed the salamanders, but in most cases they did not move away. Compiled results of the distribution of adult, year-old larvae, and recently emerged larvae are presented in fig. 3. The lighted zone contained a smaller percentage of large larvae than small larvae, and an even smaller percentage of adults. Negative photic orientation increases as larvae grow older, and is greater in adults than

	PERCENTAGE OF SPECIMENS IN:		
	LIGHT ZONE	TWILIGHT ZONE	DARK ZONE
LARVAE "A" (SNOUT-VENT: 7 TO 15 mm.)	11	89	----
LARVAE "B" (SNOUT-VENT: 18 TO 32 mm.)	7	85	8
ADULTS "C" (IN WATER)	3	27	70
ADULTS "C" (ON LAND)	1	17	82

FIGURE 3.

Compiled results of the percentage of specimens distributed through the light, twilight, and dark tank zones.

in larvae. Adults show stronger response to light, retreating farther from light than do larvae. Of the large larvae, 85 per cent were concentrated in the "twilight zone", in the dark corners behind the drop gate, while the adults, tested after the larvae had been removed from the tank, gathered behind the dark corner of the drop gate in the "dark zone." These concentrations of specimens became tangled masses in which individual salamanders were noted twisted throughout the mass, lying on their sides or upside down. Apparently the primary body orientation described by Fraenkel and Gunn(1940) as "ventral earth reaction" was overriden by the combined influences of negative photic stimulation and thigmotactic response.

SUMMARY

Field observations have determined that adult *Eurycea b. bislineata x cirrigera* from Yorktown and Williamsburg, Virginia are ordinarily found in concealment during daylight hours. If alarmed and exposed to

light they dash or swim for the nearest cover. Experiments show adults have a strong negative photic orientation, and that they retreat to the area of least light in their habitat. The ventral ground reaction of adults is overridden by strong negative photic response and thigmotaxis.

Larval animals do not show the protective behavior noted in the adults. Depending upon the extent of their cryptic mimicry, larvae either respond to alarm by swimming short distances and "freezing," or by swimming longer distances for partial concealment. Tests of photic orientation indicate that small larvae respond negatively to light, but to a lesser degree than larger larvae. As in the case of the adults, the large larvae overcame ventral ground reaction through a combination of photic orientation and thigmotaxis.

ACKNOWLEDGMENT

Mr. Robert Abraham assisted in field work and in construction of equipment. The late Dr. D. W. Davis contributed helpful suggestions and critical advice in the course of the development of this report. The author is indebted to these persons.

LITERATURE CITED

ALLEN, G. M. 1899—Notes on the reptiles and amphibians of Intervale, New Hampshire. *Proc. Bost. Soc. Nat. Hist.*, 29(3):63-75.

BISHOP, S. C. 1941—The salamanders of New York. *N. Y. State Mus. Bull.*, 324:1-365.

———— 1943—Handbook of salamanders. *Comstock Publ. Co.*, Ithaca, N. Y., pp. 1-555.

BREDER, C. M. 1947—A note on protective behavior in *Gambusia*. *Copeia*, No. 4:233-227.

BRIMLEY, C. S. 1896.—Batrachia found at Raleigh, North Carolina. *Amer. Nat.*, 30:500-501.

———— 1939—The amphibians and reptiles of North Carolina. *Carolina Tips*, Elon College, North Carolina, 2(6):19.

COLE, W. H. AND C. F. DEAN—1917. The photokinetic reactions of frog tadpoles. *Jour. Exp. Zool.*, 23:361-370.

DITMARS, R. C. 1905—The batrachians of the vicinity of New York City. *Amer. Mus. Jour.*, 5:161-206.

DUNN, E. R. 1926—The salamanders of the family *Plethodontidae*. *Smith Col. Anniv. Publ.*, pp. 1-441.

FRAENKEL, G. S. AND D. L. GUNN 1940.—The orientation in animals. *Oxford, Clarendon Press*, pp. 1-352.

NOBLE, G. K. 1931—The biology of the amphibia. *McGraw-Hill Book Co.*, N. Y., 1-577.

SHERWOOD, W. L. 1895—The salamanders found in the vicinity of New

York City, with notes upon extra-limital or allied species. *Abst. Proc. Linn. Soc.*, N. Y., No. 7:21-37.

STIER, T. J. B. 1926—Reversal of phototropism in *Diemyctylus viridescens*. *Jour. Gen. Physiol.*, 9:521-523.

SUMNER, F. B. 1934—Does "protective coloration" protect?—results of some experiments with fishes and birds. *Proc. Nat. Acad. Sci.*, 20:599-564.

SUMNER, F. B. AND N. F. WELLS 1933—The effect of optic stimuli upon the formation and destruction of melanin pigment in fishes. *Jour. Exp. Zool.*, 64:377-394.

TORELLE, E. 1903—The response of the frog to light. *Amer. Jour. Physiol.*, 9:466-488.

VERRILL, A. E. 1863—Notice of the eggs and young of a salamander *Desmognathus fusca* Baird, from Maine. *Proc. Bost. Soc. Nat. Hist.*, 9:253-255.

A New Crayfish of the Genus Orconectes from Southeastern Virginia (Decapoda, Astacidae)[1]

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Only three crayfishes of the genus *Orconectes* have previously been reported from Virginia: (1) *Orconectes limosus* (Rafinesque 1817: 42) from the northern part of the State in streams flowing into the Atlantic Ocean; (2) *Orconectes juvenilis* (Hagen 1870: 66) from tributaries of the Tennessee River, and (3) *Orconectes rusticus forceps* (Faxon 1884: 133) from the same drainage system as the latter. Furthermore, the range of the new species herein described represents the southermost limits of the range of the typically stream-dwelling members of the genus along the Atlantic seaboard.

The closest relatives of this new species are found from Ontario and New York west to Iowa and Wisconsin, and south to Ohio and adjacent West Virginia and northeastern Kentucky.

Genus ORCONECTES Cope 1872

ORCONECTES VIRGINIENSIS, sp. nov.

Diagnosis.—Eyes normal; carapace pigmented; rostrum with lateral spines, concave above, often bearing a median carina, with margins subparallel and not thickened; carapace and chela strongly setiferous; areola about 3.5 times longer than broad with six or seven punctations in narrowest part, length 28-30% of entire length of carapace; postorbital ridges terminating cephalad in spines; carapace with a single spine on each side; in male, hooks on ischiopodites of third pereiopods only. First pleopod of male reaching cephalad to coxopodite of second pereiopod; shoulder absent on cephalic surface; central projection slightly longer than mesial process, neither distinctly spatulate (figs. 1, 2, 4 & 5). Annulus ventralis weakly sculptured with a sinuous longitudinal sinus (fig. 9).

Holotypic Male, Form I.— Body subcylindrical, slightly depressed. Abdomen narrower than thorax (8.3—8.7 mm. in widest parts respectively). Width of carapace greater than depth in region of caudodorsal margin of cervical groove (8.7—7.5 mm.).

Areola moderately broad (3.5 times longer than wide) with six or seven punctations across narrowest part; cephalic section of carapace about 2.5 times as long as areola; length of areola about 28.2% of entire length of carapace.

Rostrum with subparallel margins which are not distinctly thickened

1 Contribution from the Miller School of Biology, University of Virginia.

but terminate cephalad in straight strong acute spines; upper surface deeply concave, and bearing setiferous punctations. Acumen long, subspiculiform, and extending cephalad to distal end of peduncle of antennule; tip not upturned. Subrostral ridges evident in dorsal aspect for only a short distance at their bases. A single row of setiferous punctations along mesial sides of marginal ridges extending cephalad onto acumen.

Postorbital ridges prominent, grooved dorsolaterad, and produced cephalad in well developed acute incurved spines. Suborbital angle lacking. Branchiostegal spine acute. Lateral surface of carapace with a strong acute spine on each side. Surface of carapace studded with setiferous punctations except in extreme cephalolateral ventral portions where there are setiferous granulations.

Abdomen longer than carapace (20.2—18.8 mm.).

Cephalic section of telson with two spines in each caudolateral corner.

Epistome broadly ovate without a cephalomedian projection.

Antennules of the usual form with prominent spine on ventral surface of basal segment.

Antennae broken but appear to have extended caudad beyond mid-length of abdomen. Antennal scale (fig. 7) long, moderately broad, and with a strong spine on outer distal margin; mesial margin of lamellar portion evenly rounded.

Chela somewhat depressed with the palm slightly inflated; all surfaces bearing setiferous punctations. Tubercle present on lower surface of palm at base of dactyl. Preserved specimens with a dark band encircling each finger a short distance proximad of tips. Inner margin of palm with an irregular row of ten tubercles, the proximal ones of which are spiniform; above this row an irregular one of ten smaller tubercles. Fingers only slightly gaping at base. Upper surface of immovable finger with a broad rounded submedian longitudinal ridge flanked by setiferous punctations; another ridge extends along proximal two-thirds of finger immediately mesiad to the afore-mentioned one. Outer margin of immovable finger bearing a well-defined keel which extends proximad almost to base of palm. Lower surface of finger also bearing a submedian longitudinal ridge flanked by setiferous punctations with the setae mesiad of ridge long. Opposable margin of immovable finger with a row of five small rounded tubercles along proximal half and the usual one at base of distal one-fourth; crowded minute denticles along distal two-thirds. Dactyl similar to immovable finger above and below; mesial margin with a few tubercles along basal one-fourth and not keeled; opposable margin with four or five rounded tubercles along basal half and crowded minute denticles in distal half.

Carpus longer than broad with broad shallow longitudinal furrow above; entire podomere bearing setiferous punctations. Mesial surface with a prominent curved acute spine, and upper mesiodistal margin with a somewhat smaller one; between and distad of these spines are long plumose setae; lower submedian distal margin with a small spine and lower laterodistal margin with a very strong one.

Entire surface of merus with widely scattered setiferous punctations—somewhat more numerous on upper distal surface which also bears two acute spines. Lower surface with an outer row of two very strong curved spines, and an inner row of six which are progressively

larger distad; lower laterodistal margin with one prominent spine.

Lower proximal surface of ischiopodite with a small rounded tubercle.

Hooks on ischiopodites of third pereiopods only; hooks strong and simple.

First pleopod extends cephalad to coxopodite of second pereiopods when abdomen is flexed. Tip terminating in two distinct parts which are separated for a moderate distance from tips (figs. 1 and 5). Central projection corneous, straight except for being slightly recurved at its distal end. Mesial process, which does not extend quite so far distad as does central projection, non-corneous, and while lying subparallel to the central projection is slightly convex caudad.

Morphotypic Male, Form II.—Differs from the holotype in the following respects; All spiny elements more spiculiform; carpus of cheliped with a small tubercle proximad of the large mesial spine. Upper surface of rostrum with a median longitudinal slightly elevated area (not a carina); slight differences occur in the number of tubercles on the cheliped. Hooks on ischiopodites of third pereiopods much reduced. First pleopod extend cephalad to second pereiopod when abdomen is flexed; both terminal elements non-corneous and in close apposition almost to tips (figs. 2 and 4).

Antennae extend caudad to fifth abdominal segment.

Allotypic Female.—Differs from the holotype in the following respects: Upper surface of rostrum with a median longitudinal raised area in distal portion; acumen extends slightly distad of distal end of peduncle of antennule; inner margin of palm of chela with an irregular row of eight tubercles; fingers not gaping at base; epistome broadly subtriangular.

Annulus ventralis immovable, fused cephalically with the sternum of the thorax, weakly sculptured and longest in the transverse axis. Sinus meanders along median line in the caudal two-thirds of the annulus (fig. 9).

Measurements.—As follows (in millimeters):

	Holotype	Allotype	Morphotype
Carapace—height	7.5	7.8	9.9
—width	8.7	9.2	11.4
—length	18.8	19.7	23.2
Areola—length	5.3	5.5	7.0
—width	1.5	1.2	1.9
Rostrum—length	6.5	7.2	7.6
—width	2.7	2.9	3.5
Abdomen—length	20.2	21.9	26.4
Right Chela—			
length of inner margin of palm	4.2	3.4	4.6
width of palm	4.7	4.1	5.0
length of outer margin of hand	13.2	10.9	14.1
length of dactyl	7.2	5.9	7.8

Type Locality.—Rowanty Creek, a tributary of the Nottoway River, 3.3 miles south of Reams Station on U. S. Hy. 301., Dinwiddie County,

Virginia. (Dr. Raney has kindly furnished the following data.) At this locality Rowanty Creek is a black-water stream, about thirty feet wide, flowing through a wooded swamp at a rate of about 300 cu. ft./sec. and over a sandy and gravely bottom on which detritus has collected. The temperature of the water at 10:00 A. M., March 27, 1949 was 63°F., and that of the air, 66°F. The crayfish were taken with a 10 ft. minnow seine from the shallower (up to 3 1/2 ft.) portions of the stream in an area where aquatic vegetation was sparse. This collection was made by E. C. Raney, R. D. Suttkus, H. E. Evans, and R. M. Roecker.

Disposition of Types.—The holotypic male, form I, and the allotypic female (U.S.N.M. nos. 91659 and 91660) and the morphotypic male, form II (U.S.N.M. no. 91661) are deposited in the United States National Museum. The following paratypes are retained in my personal collection at the University of Virginia: (no. 3-2148-5a, 2 males, form I, 1 female), (no. 3-2749-9b, 1 female, 1 female with eggs), (no. 3-2148-4a, 1 male, form I, 1 female), (no. 5-3149-1, 2 males, form II, 6 females), (3-2749-13b, 3 males, form I). Three paratypes (1 male, form I, 1 female, 1 immature female) are in the U. S. National Museum (no. 91666).

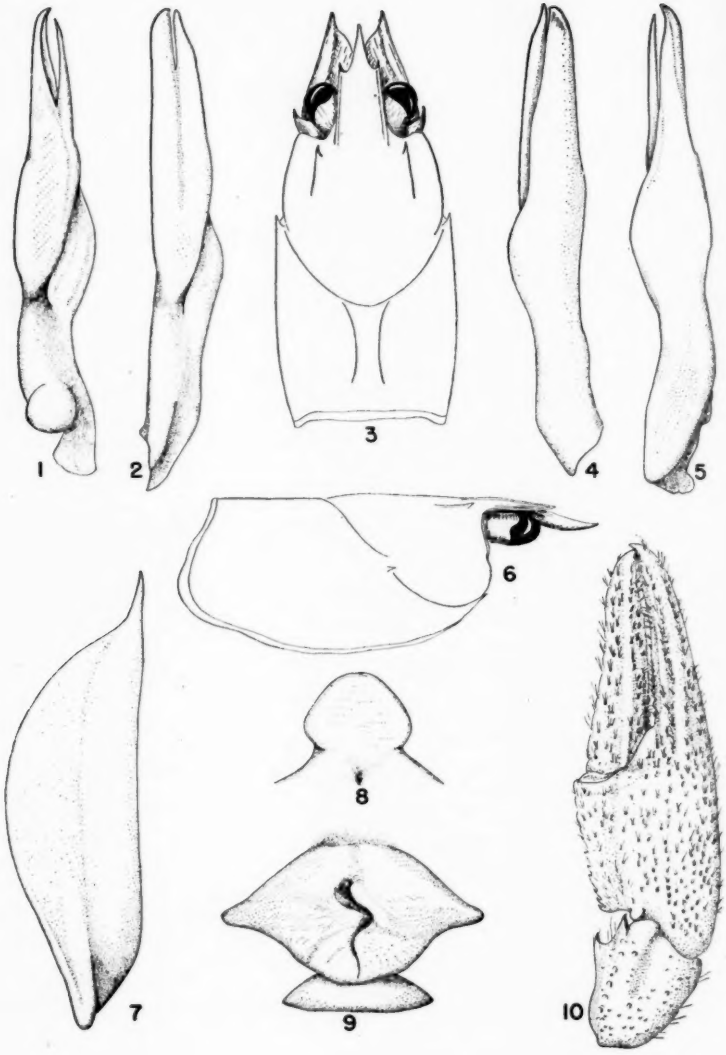
Range.—All of the specimens I have examined were collected in tributaries of the Nottoway River in Greensville, Brunswick and Dinwiddie counties, Virginia. *Greensville Co.*—Three Creek, 8.5 mi. S.W. of Jarratt on U. S. Hy. 301, coll. E. C. Raney. *Brunswick Co.*—Waqua Creek, coll. Stuart Abraham. *Dinwiddie Co.*—type locality, coll. E. C. R.; Hatcher Run, trib. of Rowanty Ck., 7 mi. S. W. of Petersburg on U. S. Hy. 1, coll. E. C. R.; Stony Ck., 1.2 mi. S. of Dinwiddie on U. S. Hy. 1, coll. E. C. R.; 17.6 mi. S. W. of Petersburg on U. S. Hy. 1., coll. P. C. Holt and M. L. Bobb.[2]

Variation.—The rostrum may or may not bear a median longitudinal ridge above. The chelae of some specimens are densely studded with setae. There are considerable variations in the number of tubercles on the chelipeds: as few as six in the row along the inner margin of the palm; as few as one on the opposable margin of the immovable finger; and none on corresponding surface of dactyl; carpus with two prominent spines on the mesial margin in some specimens; merus of cheliped with two or three spines near the upper distal margin and with two to four in the lower outer row and six to eight in the inner row; ischiopodite of cheliped with from one to three tubercles on lower proximal surface. Mesial process of first pleopod of first form male occasionally reaches as far distad as does central projection.

Relationships.—*Orconectes virginiensis* has its closest affinities with *O. propinquus propinquus* (Girard, 1852: 88), *O. propinquus sanborni* (Faxon, 1884: 128) and *O. propinquus jeffersoni* Rhoades (1944: 123). This relationship is clearly indicated by the similarity in structure of the annuli ventralis and the first pleopods of the male. It may readily be distinguished from the three subspecies of *O. propinquus* by the more densely punctate and strongly pubsecent carapace and chelae, and by comparing the annuli ventralis and first pleopods, It is somewhat more distantly related to *O. obscurus* (Hagen, 1870: 69).

The range of *O. propinquus propinquus* extends from Ontario and New York west to Iowa and Wisconsin, where it inhabits streams flowing

[2] I wish to thank Dr. Edward C. Raney, Dr. M. L. Bobb, and Mr. P. C. Holt for the specimens on which this description is based.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into the Great Lakes and St. Lawrence River. *O. propinquus sanborni* occurs in streams in the Ohio drainage system in southern Ohio, West Virginia, and Kentucky. The third subspecies of *O. propinquus, O. propinquus jeffersoni,* is known only from Jefferson County, Kentucky.

O. obscurus frequents the upper Ohio, Alleghany, and Monongahela rivers in Pennsylvania and northern West Virginia. It has also been found in the headwaters of the Potomac River in eastern West Virginia and Alleghany Co., Maryland.

AN ARTIFICIAL KEY TO THE SPECIES OF THE GENUS *ORCONECTES* OCCURRING IN VIRGINIA OR WHICH MAY BE EXPECTED TO BE FOUND HERE

1	Sides of carapace with more than one spine on each side..... ..... *Orconectes limosus* (Rafinesque)	
1′	Sides of carapace with only one spine on each side.....	2
2(1′)	Margins of rostrum thickened and concave laterally..... ..... *O. rusticus forceps* (Faxon)	
2′	Margins of rostrum not thickened, and convergent or subparallel	3
3(2′)	Margins of rostrum convergent; rostrum without a median carina ..... *O. obscurus* (Hagen)	
3′	Margins of rostrum parallel or nearly so; median carina present or absent	4
4(3′)	Male with first pleopods reaching coxa of cheliped when abdomen is flexed; annulus ventralis of female with a deep horizontal depression ..... *O. juvenilis* (Hagen)	
4′	Male with first pleopods reaching coxa of second pereiopod when abdomen is flexed; annulus ventralis with no distinct horizontal depression ..... *O. virginiensis* sp. nov.	

LITERATURE CITED

FAXON, W. 1884—Descriptions of new species of Cambarus; to which is added a synonymical list of the known species of Cambarus and Astacus. *Proc. Amer. Acad. Arts and Sci.,* 20: 107-158.

EXPLANATION OF FIGURES.—(*Pubescence removed from all structures illustrated except in figure* 10.) 1. Mesial view of first pleopod of holotype. 2. Mesial view of first pleopod of morphotype. 3. Dorsal view of carapace of holotype. 4. Lateral view of first pleopod of morphotype. 5. Lateral view of first pleopod of holotype. 6. Lateral view of carapace of holotype. 7. Antennual scale of holotype. 8. Epistome of holotype. 9. Annulus ventralis of allotype. 10. Upper surface of carpus, propus and dactyl of first pereiopod of holotype.

GIRARD, C. 1852—A revision of the North American Astaci, with observations on their habits and geographical distribution. *Proc. Acad. Nat. Sci., Philad.*, 6: 87-91

HAGEN, H. A. 1870—Monograph of the North American Astacidae. *Ill. Cat. Mus. Comp. Zool., Harvard Coll.*, (3): 1-109, pls. 1-11.

RAFINESQUE, C. S. 1817—Synopsis of four new genera and ten new species of crustaceans found in the United States. *Amer. Monthly Mag. and Crit. Rev.*, 2, Art 7, (9): 40-43.

RHOADES, R. 1944—The crayfishes of Kentucky, with notes on variation, distribution and descriptions of new species and subspecies. *Amer. Midl. Nat.*, 31 (1): 111-149, 10 figs., 10 maps.

News and Notes

(Editor's note: News contributions should be sent to the person whose name appears at the end of the appropriate section.)

WORTLEY FULLER RUDD

Wortley Fuller Rudd, Ph.B., M.A., Sc.D., L.H.D., Dean Emeritus of the School of Pharmacy of the Medical College of Virginia, died in Richmond, Virginia, on July 26, 1950. He was born at Skinquarter in Chesterfield County, Virginia, on October 6, 1876. There he received his early education, moving on later to the University of Richmond, where he was awarded the A.B. degree in 1898. Following a period of high school teaching at Brookneal Institute and in the public schools of Manchester and Richmond, Dean Rudd entered the Medical College of Virginia and received the Bachelor of Pharmacy degree in 1902. During his early years of college teaching, he attended summer sessions at Columbia University, where he received the degree of Master of Arts in chemistry in 1911. His appointment as Instructor in Pharmacy in the Medical College of Virginia came in 1906, as Professor of Chemistry in 1910. In 1920 he succeeded Albert Bolenbaugh as Dean of the School of Pharmacy, which post he held until his retirement on July 1, 1947.

Dean Rudd served as president of the American Association of Colleges of Pharmacy, the Southern Association of Science and Industry, the Virginia Academy of Science and the Virginia Section of the American Chemical Society. He also served on the governing boards of the Richmond Professional Institute and the College of William and Mary and the Virginia State Chamber of Commerce.

His term as first president of the Southern Association of Science and Industry gave impetus in its beginning to an organization now grown strong in its objective of bringing about closer coordination between Southern educators, scientists and industrialists. He received the Distinguished Service Award from the Virginia Section of the American Chemical Society in 1948. His presidency of the Virginia Academy of Science was prosecuted with such effectiveness that in 1941 he was named Virginia's man of the year in Science and in 1950 an honorary member of the Academy. He received the honorary doctorate of science from the University of Maryland in 1941, and the accompanying citation praised him for "doing as much, if not more, than any one person as teacher, writer, editor and association worker, to advance the standards

of pharmaceutical education, to elevate the practice of pharmacy and to enlist the support of pharmacists for the advancement of science in general."

His contributions were also recognized by the University of Tampa, which conferred upon him an honorary doctorate of humane letters, and by the Medical College of Virginia, which conferred upon him his second honorary doctorate of science. One of his most cherished possessions was the Herty Medal, awarded him by the Georgia Section of the American Chemical Society for his outstanding contributions to chemistry in the Southeast.

This partial recitation of his achievements tells but little of the man who taught and was loved and respected by several generations of students for his high character and personal traits.

Many had the delightful experience of being guests in the home which he made with his beloved wife, the former Kate Porter Vaden, who died on March 13, 1951. Here they welcomed their friends, young and old, and it was an unusual evening which did not find them entertaining informally those who dropped in at 1614 Park Avenue. Those who knew the warmth of their friendship and hospitality will never forget Dean and Mrs. Rudd.

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SECTION NEWS

AGRICULTURAL SCIENCE SECTION

Associate Professor S. H. Byrne of the Agricultural Engineering Department, Virginia Polytechnic Institute, began a two-year leave July 1, 1950, to attend Iowa State College for further study toward completing work for his doctorate degree.

During Professor Byrne's absence, Associate Professor U. F. Earp was transferred from half-time research and half-time college teaching to three-fourths college time. He was also appointed Acting Course Advisor while Professor Byrne is on leave.

B. F. Parker and F. E. White joined the Agricultural Engineering Department on September 1, 1950. Mr. Parker received his B. S. from the Virginia Polytechnic Institute and Mr. White received his B.S. from North Carolina State College.

Mr. William E. Chappell and Mr. John I. Shafer have recently joined the staff of the Department of Plant Pathology and Physiology, as physiologist and associate physiologist, respectively. Mr. Chappell received his Ph.D. degree from Cornell University and came to Virginia Polytechnic Institute from the Herbicide Testing Laboratory at Beltsville, Md. of which he was head for the past three years. Mr. Shafer received his Ph.D. degree from Cornell University, spent three years in vegetable research at the New York Experiment Station at Geneva, and came to Virginia Polytechnic Institute from the University of Wisconsin where he had been employed as instructor in botany. Mr. Chappell will conduct research on weed control. Mr. Shafer will do half-time research for station and half-time teaching for the college.

Two new research laboratories are now available for the staff and students of the Department of Horticulture at the Virginia Polytechnic Institute, for conducting projects involving various chemical and physiological tests. A large new processing laboratory has been established which includes three walk-in refrigerated storages. With the equipment which is available, this makes it one of the better processing laboratories in this part of the country.

—T. J. NUGENT, BOX 2160, NORFOLK.

ASTRONOMY, MATHEMATICS, AND PHYSICS SECTION

Mr. Harold L. Alden, Director of the McCormick Observatory of the University of Virginia, is Chairman of the Astronomy Section of the AAAS.

Mr. Linwood A. Cosby has joined the Physics Department of the Virginia Military Institute.

Members of this Section have heard with regret of the death of Mr. C. Y. Hsu, Chairman of the Department of Physics at Hampton Institute. Dr. Hsu was a native of China, but received his education

in this country, earning degrees from the University of Richmond, the University of Chicago, and Cornell University. Hs served as Professor of Physics at several Chinese universities, and returned to this country in 1948. He has been at Hampton since 1949.

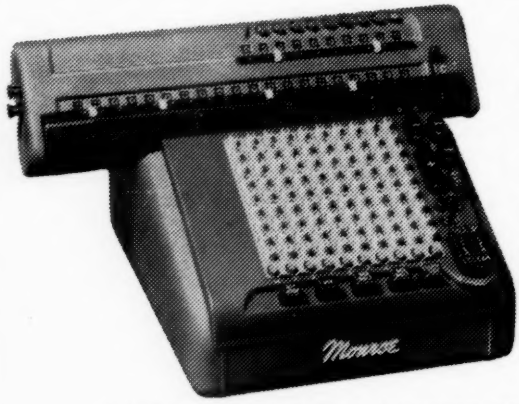
The Sigma Xi lecturer for this year is Mr. George Gamow, Professor of Theoretical Physics at George Washington University. Sigma Xi chapters at the Virginia Polytechnic Institute and the University of Virginia have had the pleasure of hearing his lecture on "The Origin and Evolution of the Universe."

Three members of this Section are serving on the Governor's Advisory Council dealing with defense against atomic bombing. They are Mr. T. E. Gilmer of Hampden Sidney and Messrs. Jesse Beams and E. C. Stevenson of the University of Virginia.

The Fourth Annual Conference of Mathematics Teachers was held at the University of Virginia on February 23 and 24. Several members of this Section attended the seminars on Mathematics Teaching in High Schools, Mathematics Preparation needed by the Armed Services, Laboratory for the Production of Aids in Teaching Mathematics.

Henry Louis Smith

In the recent death of Mr. Henry Louis Smith physics has lost one of its pioneers of the southeastern region. Mr. Smith is said to



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have been the first physicist in the United States to apply Roentgen's discovery of X-rays in the field of medical X-ray photography. He was also responsible for the development of the small balloons used to carry propaganda messages to Germany in the First World War. Although born in Greensboro, North Carolina, he came of an old Virginia family, and was educated at Davidson College and the University of Virginia, the latter from which he received his Ph.D. degree. He later did post-graduate work at Harvard and Cornell. In 1887 he became Professor of Physics at Davidson College and was made the President. In 1912 he accepted the Presidency of Washington and Lee University, where he served until 1929. He retired as President Emeritus and resided in Greensboro until his death.

—I. G. FOSTER, VIRGINIA MILITARY INSTITUTE.

BIOLOGY SECTION

Mr. Ivey F. Lewis, honorary member of the Academy and Dean of the University of Virginia, has recently been elected Chairman of Section G, Botanical Sciences, and Vice-President of the American Association for the Advancement of Science.

Mr. Edwin W. Pullen, graduate student and Instructor in Biology in the Miller School of Biology, University of Virginia, has accepted a teaching position in the School of Anatomy, Department of Medicine, University of Virginia.

Mr. Walter S. Flory, Blandy Experimental Farm, University of Virginia was recently awarded the President and Visitors' Research Prize. The especially meritorious paper which was the basis of the award was published in the first volume of the Virginia Journal of Science., N. S.

Mr. Warwick Reed West, Jr. has been awarded the Andrew Fleming Prize in Biology, University of Virginia. This Prize is given annually to a graduate student for excellence in scholarship and research accomplished. Mr. West did his undergraduate work at Lynchburg College.

—LADLEY HUSTED, UNIVERSITY OF VIRGINIA.

CHEMISTRY SECTION

Mr. E. A. Tippetts, of du Pont, in Richmond, has been made director of viscose rayon research, and has moved to Wilmington.

Dr. Lyndon F. Small, formerly active in the Academy, has succeeded Dr. C. S. Hudson as Chief of the National Institute of Arthritic and Metabolic Diseases of the National Institute of Health.

Dr. Garnett Ryland, long active in the affairs of the Academy, is one of twenty-four who will be honored at the national spring meeting of the American Chemical Society on their completion of fifty years of continuous membership.

From the Virginia Polytechnic Institute:

Mr. F. C. Vilbrandt, head of the department of chemical engineering, attended a meeting in Richmond in January of the Committee on Industry, Advisory Council of Virginia Economy.

Mr. Nelson F. Murphy, Research Professor of Chemical Engineering, recently attended a research conference in Dayton, Ohio, of the Air Material Command, in connection with work being conducted at the Institute.

Mr. Frank Vingiello, associate professor of chemistry, attended a conference on "Mechanisms of Organic Reactions," in Evanston, Illinois, August 29 through September 2.

From the Medical College of Virginia:

Dr. G. Watson James, III, and Dr. Lynn D. Abbott presented a paper at the American Federation for Clinical Research, held in New Orleans on January 26, 1951. The title of the paper was "Nitrogen and Phosphorus Metabolism in Pernicious Anemia during Remission Induced by Crystalline Vitamin B_{12}."

Dr. Nelson F. Young attended the symposium on radioisotopes, held in New York, on January 19, 1951.

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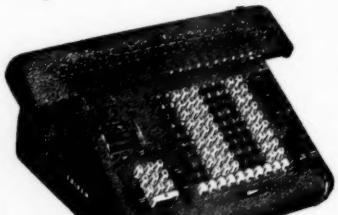

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Some publications from the Medical College of Virginia:

J. C. Forbes, C. D. Cox, and J. D. Smith, "Effect of Certain Hendecynoic Acids and their Ammonium Salts on Acid Production in Saliva Containing Glucose." *Journal of Dental Research,* October, 1950.

J. C. Forbes and G. M. Duncan, "Effect of Alcohol on Liver Lipids and on Liver and Heart Glycogen,"*Quarterly Journal of Studies on Alcohol,* September, 1950.

R. W. Fowkles and J. C. Forbes, "Cholesterol Fractionation Studies of the Serum on Xanthelasma Patients," *Archives of Dermatology and Syphilology,* November, 1950.

Some publications from the University of Virginia:

W. R. Nes and Alfred Burger, "Amine and Enol Derivatives of 1,1,1-Trifluoropropane," *Jour. Am. Chem. Soc.,* **72**, 5409 (1950).

Alfred Burger and William B. Bennett, "Amine Derivatives of 2,2-Diphenyl cyclohexanone," *Jour. Am. Chem Soc.,* **72**, 5415 (1950).

Alfred Burger, L. B. Turnbull, and J. G. Dinwiddie, Jr., "Some Derivatives of Tetrahydropyranones. Potential Pharmacodynamic Agents. II," *Jour. Am. Chem. Soc.,* **72**, 5513, (1950).

R. E. Lutz, Rosser L. Wayland, Haywood G. France, "Reduction of alpha-Haloketones to Halohydrins by Lithium Aluminum Hydride," *Jour. Am. Chem. Soc.,* **72**, 5511, (1950).

Lester P. Kuhn, R. E. Lutz, and Carl R. Bauer, "A Spectroscopic Study of Cis- and Trans-Dibenzoylethylenes and Related Compounds," *Jour. Am. Chem. Soc.,* **72**, 5038 (1950) —WILLIAM E. TROUT, JR., BOX 168, UNIVERSITY OF RICHMOND, VIRGINIA.

EDUCATION SECTION

Kellogg Foundation Supports Project in School Administration

School administrators in Virginia will participate in a nation-wide project for the improvement of educational administration. The project is sponsored by the American Association of School Administrators and financed by the Kellogg Foundation. Three million dollars have been made available for the nation-wide project during a five-year period. This fund will be administered by six institutions, representing various regions of the United States (Harvard University, Teachers College of Columbia University, Peabody College, University of Chicago, University of Texas, and a university in the west to be selected).

A committee has been appointed by the State Superintendent of Public Instruction to co-ordinate the activities in Virginia which come within the Cooperative Program of Educational Administration. The first meeting of this committee was held at the University of Virginia, March 8. The following members attended and participated in the discussions: Dowell J. Howard, Superintendent of Public Instruction;

Lindley J. Stiles, Dean, Department of Education, University of Virginia; George J. Oliver, Head of Department of Education, College of William and Mary; Robert O. Nelson, President of Superintendents Association; William J. DeLong, President of Secondary School of Principals Association; Ethel Nash, President of Elementary School Principals Association; and J. T. Henley, Chairman, Albemarle County School Board.

Projects which may be undertaken in Virginia will not be under the supervision of either of the regional institutions, but consultative service will be available from project staff members located at both Peabody College and Teachers College.—F. G. LANKFORD, JR., PEABODY HALL, UNIVERSITY OF VIRGINIA.

ENGINEERING SECTION

The following minutes of the business meeting of the Engineering Section of the Academy were omitted from the Proceedings for 1949-50.

At a business meeting of the section the following officers were elected for 1950-51: R. E. L. Gildea, Chairman, University of Virginia; B. A. Niemeier, Secretary, Experiments, Incorporated, and Nelson F. Murphy, Section Editor, Virginia Polytechnic Institute.

The nominating committee consisted of Prof. F. C. Vilbrandt and

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D. H. Pletta of the Virginia Polytechnic Institute, and Prof. R. M. Hubbard of University of Virginia.

The second annual Engineering Conference, under the auspices of the Association for the Advancement of Engineering, an organization of all engineering students, was held at the Virginia Polytechnic Institute on February 23, 1951. Mr. John A. Umlauf, Richmond, is president of the organization.

Leo J. Pantas, manager, Salem division, Yale & Towne Manufacturing Co., was the featured speaker at the annual banquet held during the evening of the first day of the two-day session, February 23 and 24.

Earlier in the day Dr. Thomas A. Boyd, Research Consultant, Research Laboratory Division, General Motors Corp.; Paul H. Robbins, Executive Director, National Society of Professional Engineers; and Philip Sporn, president, American Gas and Electric Service Corp., spoke at a convocational session which opened the conference.

Industrialists from three states and the District of Columbia attended the event, and many of them held interviews with engineering seniors who expect to be graduated in June.

Through the two days, all the departments of the buildings, and some of the professional and honorary fraternities as well as curricular clubs also had displays.

Dr. Walter S. Newman, President of the Virginia Polytechnic Institute, was the speaker at the Friday luncheon held in the small hall of the main dining hall. He was high in his praise of the students for their farsightedness in the program, and spoke of the balance between theory and application they received in their engineering training. He also spoke of the research corporation set up by the last General Assembly, which made the corporation known as the Virginia Engineering Experiment Station where, through a small appropriation, work will be done on basic research. When the point arrives where some practical application is shown, industry will take over. The program is designed primarily to aid Virginia industry.

Pantas, in his address, called the 20th century "the century of the engineer. Never before," he claimed, "has American industry offered such opportunity as it does today to the engineer. In our own country, where the American dream of a rich full life for all our people is still unfilled, there is enormous work to be done."

He warned the young engineers and students that "I do not mean to say that your engineering degree, of itself, will be an open sesame to a glorious and successful future."

Sporn, speaking Friday morning, doubted the practicality of the commercialization of atomic energy. "I like to think the second industrial revolution began five years ago, and we are headed into the results now."

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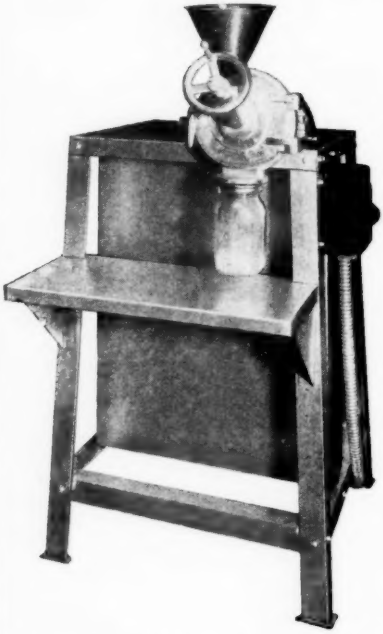

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Dr. Boyd emphasized that many big war developments result from "researches done in the period of peace preceding the war. In World War II that was true of 100 octane aviation gasoline, of synthetic rubber, of radar, of the atom bomb and most of the other developments that helped us on to victory."

Robbins discussed the pressing need for engineers. According to Robbins, there is a shortage. He said, "Within a month or six weeks after they graduated last year, 50,000 engineers had jobs and there were still jobs to be filled."

Friday afternoon was devoted to forums or symposia in each engineering department. The speakers and discussion leaders for these symposia were alumni and officials experienced in the separate fields.

The activities closed with an Engineering Ball on Saturday evening, where President Newman crowned Miss Gloria Fenderson, of Petersburg, as Queen of Engineering.—NELSON F. MURPHY, VIRGINIA POLYTECHNIC INSTITUTE.

GEOLOGY SECTION

William M. McGill, State Geologist, reports that the survey and mineral evaluation of certain tracts forming Virginia's part of Cumberland Gap National Historical Park have been completed by W. T. Harnsberger and H. C. Sunderman, staff geologists. Mr. Sunderman also completed a preliminary examination of reported explorational activities for manganese in Russell County. The State Geological Survey, in cooperation with the Federal Geological Survey, has begun a restudy of the coal resources of Virginia, which will require two to four years to complete.

Mr. S. S. Obenshain, agronomist for the Virginia Agricultural Experiment Station, reports the recent inauguration of a research project on the fundamental properties of soils, which will be concerned in part with the clay mineralogy of soils. The work is being done by Messrs. Charles I. Rich and J. D. Pendleton. Field soil surveys are now in progress in Nottoway and Norfolk counties.

Mr. William T. Parrott, engineering geologist for the Virginia Department of Highways, presided at the Department's second symposium on geology as applied to highway engineering, which was held in the auditorium of the Highway Building in Richmond, February 16. Approximately 150 geologists and engineers attended. Among the papers presented were those by A. B. Cornthwaite, Frank W. Wheeler, and Byron N. Cooper. The 1952 symposium will be held at Virginia Military Institute, Lexington, with Mr. Robert L. Laurence of the U. S. Geological Survey in charge of the program.

The Third Southeastern Mineral Symposium was held at Emory University, Atlanta, Georgia, on March 29-April 1, with several hundred geologists and engineers attending. Messrs. B. N. Cooper and W. D.

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SPECTROPHOTOMETERS
IRONWARE

Lowry, of the geology department of Virginia Polytechnic Institute, attended the meeting and also the preliminary organizational meeting of the newly authorized Southeastern Section of the Geological Society of America. The Planning Committee of the Mineral Symposium received an invitation for the 1952 symposium to be held at Virginia Polytechnic Institute.—BYRON N. COOPER, VIRGINIA POLYTECHNIC INSTITUTE.

PSYCHOLOGY SECTION

The Society of Experimental Psychologists held its annual meeting at the University of Virginia on March 20 and 21. This was the first time that this distinguished group of psychologists had met in Virginia, and only its second meeting at a Southern institution. Mr. Frank A. Geldard is the Society's Chairman.

The annual meeting of the Southern Society for Philosophy and Psychology was held in Roanoke on March 22-24, with Washington and Lee, Hollins, and Roanoke College as co-host institutions. William M. Hinton was in charge of local arrangements for the meetings. State psychologists were strongly represented on the program. Six papers were presented by Virginia psychologists, while others participated in the Symposium on Learning Theory (F. W. Finger, S. B. Williams, and L. S. Reid), and in the joint philosophy-psychology session on "Cybernetics in Relation to a Theory of Mind" (R. H. Henneman). D. M. Allan is Secretary of the Society, while R. H. Henneman is Society Treasurer.

The Virginia Examining Board for Clinical Psychologists issued, on November 18, its certificate to Mrs. Lois S. Kriegman of Richmond, after examination, and to Mr. Gilbert J. Rich of Roanoke, by reciprocity.

Mr. Frank A. Geldard has recently assumed the Chairmanship of the Human Resources Committee, Research and Development Board, Office of the Secretary of Defense, replacing Mr. Donald G. Marquis of the University of Michigan. Civilian members of the Committee continue to be: Mr. C. L. Shartle, Mr. S. A. Stouffer, and Mr. W. C. Menninger. Prof. W. S. Hunter of Brown University is Deputy Chairman.

John N. Buck conducted a five-day Workshop on the H-T-P, under the auspices of the Veterans Administration Mental Hygiene Clinic in Philadelphia, February 12-16—RICHARD H. HENNEMAN, UNIVERSITY OF VIRGINIA.

STATISTICS SECTION

G. W. Tyler has left the Navy Electronics Laboratory in San Diego and is now with the Department of the Air Force.

Boyd Harshbarger has returned from a consulting post with the Navy Electronics Laboratory in San Diego.

J. Youden delivered the Sigma Xi Lecture at Virginia Polytechnic Institute.

G. W. Suter is now with the Crop Reporting Service in Richmond.

W. S. Flory of the Blandy Experimental Farms, University of Virginia, lectured at the Virginia Polytechnic Institute joint seminar in Statistics and Horticulture.

R. A. Bradley and M. E. Terry of Virginia Polytechnic Institute delivered a joint paper at the Oak Ridge meetings of the Biometrics Society, which were also attended by Boyd Harshbarger and D. B. Duncan of Virginia Polytechnic Institute.

A special section of the Engineering Statistics course is being offered at the Radford Arsenal as a service of the Virginia Polytechnic Instiute.

A program of intensive courses August 8-25 running two hours each per day and carrying full college credit wil be conducted by the Department of Statistics of the Virginia Polytechnic Institute and the United States Department of Agriculture at the Virginia Polytechnic Institute. Seminar speakers will include some of the nation's distinguished statisticians. For further information write to the Department of Statistics.

M. E. TERRY, VIRGINIA POLYTECHNIC INSTITUTE.

Virginia Academy of Science

Program

OF THE

Twenty-ninth Annual Meeting

AT LYNCHBURG COLLEGE

LYNCHBURG, VIRGINIA

May 10, 11, 12, 1951

HOST: LYNCHBURG COLLEGE

Virginia Academy of Science

OFFICERS

GUY W. HORSLEY, *President*
E. C. L. MILLER, *Secretary-Treasurer Emeritus*
FOLEY F. SMITH, *Secretary-Treasurer*
PAUL M. PATTERSON, *President-Elect*

COUNCIL

(Board of Trustees)

Elected Members

EDWARD S. HARLOW (1951)
ALLAN T. GWATHMEY (1952)
MARCELLUS H. STOW
BOYD HARSHBARGER
JOHN N. BUCK (1953)
LADLEY HUSTED (1954)
B. W. JARMAN (1955)
HORTON H. HOBBS, JR.

Ex-Officio Members

JESSE W. BEAMS (1951)
SIDNEY S. NEGUS (1952)
BOYD HARSHBARGER (1953)

LOCAL COMMITTEE ON ARRANGEMENTS

HAROLD H. GARRETSON, *Co-Chairman*
RUSKIN S. FREER, *Co-Chairman*
JOHN G. MAHAN, V. HOWARD BELCHER, *Meeting Rooms*
RUTH R. BAHOUS, MABEL A. SAWYER, *Registration*
GROVER W. EVERETT, *Housing and Parking*
M. WELDON THOMPSON, *Projection Equipment*
MERVYN W. WILLIAMSON, *Public Relations*
CLYDE E. MILLER, JOHN G. MAHAN, *Exhibits*
PEARL G. GRIFFIN, SALLIE SCOTT, *Dinners and Luncheons*
WILSON F. WETZLER, *Guest Speakers*
DONALD D. SHIPLEY, LAURA JETER PARKER, ALBERT H. SHUSTER, JR.,

Junior Academy

Members at large

ORVILLE W. WAKE, *President*
FRED HELSABECK, *Dean*
CHRISTINE K. WELLS, *Dean of Students*

HOST TO MEETING

LYNCHBURG COLLEGE, ORVILLE W. WAKE, *President*

Announcements

ROOM RESERVATIONS

Room reservations should be made with Grover W. Everett, Lynchburg College, by May 5. Please state preference for hotel or motor *court*; single or double room. State approximate amount you would like to pay for these accommodations.

INFORMATION CENTER

An Information Center to assist members and guests will be maintained by the local committee on arrangements near the registration desk in the parlors of Westover Hall, the girls' dormitory.

JUNIOR ACADEMY OF SCIENCE

The Junior Academy of Science, under the leadership of Flood S. Andrews and B. N. Cooper, of Virginia Polytechnic Institute, Co-Chairmen of the Academy Committee, will hold its own meeting at Lynchburg College, Thursday, May 10. Members of the Junior Academy, those participating in the Virginia Science Talent Search and the Virginia Science Club Contests, and senior scientists who are interested in the activities of these juniors are urged to register from 3:00 to 9:00 P. M., Wednesday, May 9, in the foyer of Memorial Gymnasium. Those who arrive in the morning of May 10 will complete their registration at 8:00 A. M.

VIRGINIA SCIENCE TALENT SEARCH

All contestants in the Virginia Science Talent Search are requested to report to P. C. Scherer, Committee Chairman, in Music Studio A, Memorial Gymnasium, at 10:30 A. M., May 10.

In the National Science Talent Search, conducted by Science Clubs of America for the Westinghouse Science Scholarships, the following Virginia entrants received Honorable Mention.

Bayne Samuel Bentley, Jefferson H. S., Roanoke
Ada Ann Blackwell, Wilson Memorial H. S., Fishersville
Fay Francis Dixon, Wilson Memorial H. S., Fishersville
Marcella Maxine Eubank, Wilson Memorial H. S., Fishersville
William Thomas Graham, Wilson Memorial H. S., Fishersville
Richard Kenneth Lyon, Washington Lee H. S., Arlington
Ellen Dolores Valentine, George P. Phenix H. S., Hampton.

Members of the Junior Academy of Science, including the Science Talent Search, Science Club contests, nad Individual contests, will meet at the entrance of Westover Hall at 6:00 P. M., May 10, for a Junior-Senior Get Together. Senior members are especially urged to attend this function and to become acquainted with the Junior members who have requested the opportunity to meet the Senior scientists. At 6:30 P. M., those participating in the Virginia

Science Talent Search, Science Club Contest, and Exhibit Contest will be honor guests of Lynchburg College at the Junior Dinner. Certain senior members and outstanding scientists will also be present. Chairmen of the various senior sections have been requested to invite outstanding scientists in their respective fields to attend this function. The Senior members and other Juniors will pay $1.50 per plate for the banquet, and should make their reservations as soon as possible, at least before 4:00 P. M., May 10.

MEETINGS OF SENIOR MEMBERS ON THURSDAY, MAY 10

1. The President's Advisory Committee; 3:00 P. M., Room 16, Main Building.
2. The Council; 4:00 P. M., Room 16, Main Building.
3. The Academy Conference and General Meeting; 8:00 P. M., College Auditorium, Main Building.
4. The Editors; 5:00 P. M., Room 15, Main Building.

LUNCHEON ON FRIDAY, MAY 11

A luncheon for members of collegiate chapters and other collegiate members will be held at 12:30 P. M., College Dining Hall, Westover Hall. Tickets must be purchased before 10:00 A. M.

THE RECEPTION

President Wake of Lynchburg College and officers of the Academy will be hosts at a reception for all Junior and Senior members in the parlors of Westover Hall, from 4:00 to 6:00 P. M., Friday, May 11.

THE ACADEMY DINNER

Tickets for the Academy Dinner must be purchased before noon on Friday. The price of the tickets will be $2.50. Dinner will be served at 7:00 P. M. Dress will be informal.

EXHIBITS

The Academy will continue the sponsoring of commercial and educational exhibits.

RESEARCH COMMITTEE

H. Rupert Hanmer, Chairman of the Academy Research Committee, has called a luncheon meeting of the committee for 12:30 P. M. on Friday, May 11, in the Faculty Lounge in Westover Hall.

MEMBERSHIP

Foley F. Smith, Chairman of the Academy Membership Committee, urges each member to invite teachers of science, those in scientific pursuits in industry, and laymen of broad interests in science to become members of the Academy. The dues are nominal and college students are eligible to membership at reduced rates. Mr. Smith

will be available during the meeting at a desk near registration headquarters. Please aid the secretary-treasurer's office by paying your Academy dues for 1951-52 ($3.00) to Mr. Smith during the meeting.

FIELD TRIPS AND LAST-MINUTE CHANGES

Special announcements concerning field trips on Saturday afternoon, tours, and last-minute changes will be posted on bulletin boards near the Information Center in Westover Hall, and the Main Building where most section meetings will be held.

General Program of The Twenty-Ninth Annual Meeting

1951

WEDNESDAY, MAY 9, LYNCHBURG COLLEGE LYNCHBURG, VIRGINIA

3:00 P. M.—Registration at the College for Junior Academy members, participants in the Science Talent Search, Senior Scientists and Guests. Foyer, Memorial Gymnasium.

THURSDAY, MAY 10, LYNCHBURG COLLEGE

8:00 A. M. to 9:00 A. M.—Setting up Exhibits. Memorial Gymnasium.

8:00 A. M. to 9:00 P. M.—Registration for Junior and Senior Scientists and Guests, Westover Hall.

10:30 A. M.—Participants in the Science Talent Search meet with P. C. Scherer in Music Studio A. Memorial Gymnasium.

10:30 A. M.—Participants in Science Exhibit Contest meet with F.S. Andrews and B. N. Cooper, Music Studio B, Memorial Gymnasium.

11:00 A. M. to 3:00 P. M.—Judging of those entering the Science Talent Search, Music Studio A. Memorial Gymnasium and Rooms 1 and 2, Memorial Gymnasium.

12:30 P. M.—Radio Program.

1:00 P. M. to 2:30 P. M.—Judging of Science Exhibit Contests, Memorial Gymnasium.

3:00 P. M.—Meeting of Junior Committee, Room 13, Main Building.

3:00 P. M.—Meeting of the President's Advisory Committee, Room 16, Main Building.

3:30 P. M.—Annual Business Meeting of the Junior Academy of Science, Auditorium, Main Building.
Invited Lecturer: Dr. Harold H. Garretson, Professor of Chemistry, Lynchburg College.

4:00 P. M.—Meeting of the Council of the Senior Academy, Room 16, Main Building.

5:00 P. M.—Meeting of the Editors of the Virginia Journal of Science, Room 15, Main Building.

6:00 P. M.—Junior-Senior Get Together, Westover Hall.

6:30 P. M.—Junior Academy Dinner, College Dining Hall, Westover Hall.

Presiding—Billy Graham, *President of the Junior Academy*

Greetings—Guy W. Horsley, *President*

Welcome Address—Billy Graham

Presentation of Junior Academy Awards—Dr. B. N. Cooper

Presentation of Virginia Science Talent Search Awards —P. C. Scherer

Address—Dr. Ladley Husted, Head, Miller School of Biology, University of Virginia

8:00 P. M.—Junior Social Hour, Parlors, Westover Hall

8:00 P. M.—Academy Conference and General Meeting, College Auditorium, Main Building

Report of Officers

Report of Committees

Long Range Planning—Marcellus H. Stow, *Chairman*
Research Committee—H. Rupert Hanmer, *Chairman*
Finance and Endowment—Robert F. Smart, *Chairman*
Junior Academy of Science—F. S. Andrews, *Co-Chairman*
Speakers Bureau—Frank C. Vilbrandt, *Chairman*
Virginia Science Talent Search—P. C. Scherer, *Chairman*
Activities for Collegiate Members—Joe W. Guthridge, *Chairman*
Exchange of Foreign Students—Edgar J. Fisher, *Chairman*
Membership—Foley F. Smith, *Chairman*
James River Project—Marcellus H. Stow,*Chairman*
Resource-Use Education—Alfred L. Wingo, *Chairman*
Virginia Flora—A. B. Massey, *Chairman*
Virginia Fauna—J. D. Andrews, *Chairman*
Virginia Journal of Science—Horton H. Hobbs, Jr., *Technical Editor*
Financial Report of Virginia Journal of Science —Boyd Harshbarger, *Editor-in-Chief*
Science Museum—George W. Jeffers, *Chairman*
Place of Meeting for 1952—William G. Guy, *Chairman.*
Local Arrangements—Ruskin S. Freer, *Co-Chairman*
Institute for Scientific Research—Allan T. Gwathmey, *Director*

New Business

FRIDAY, MAY 11, LYNCHBURG COLLEGE

8:00 A. M.—Registration in Westover Hall.

9:00 A. M.—Section Meetings—

Agricultural Sciences, Library
Astronomy, Mathematics and Physics, Room 1, Main Building
Bacteriology, Small Biology Laboratory, Biology Building
Biology, Biology Lecture Room, Biology Building
Chemistry, Auditorium, Main Building
Education, Room 14, Main Building
Engineering, Room 12, Main Building
Geology, Room 25, Main Building
Medical Science, Large Biology Laboratory, Biology Building
Psychology, Room 16, Main Building
Science Teachers, Room 13, Main Building
Statistics, Room 22, Main Building.

12:30 P. M.—Luncheon for members of collegiate chapters and other collegiate members, College Dining Hall, Westover Hall.

12:30 P. M.—Group Luncheons.

1:00 P. M.—Industrial Tour for Junior Academy Members.

2:00 to 4:00 P. M.—Section Meetings.

4:00 P. M.—Section meetings adjourned. Junior and Senior members of the Academy to be guests at a reception in Westover Hall.

7:00 P. M.—Academy Dinner, Memorial Gymnasium. Tickets must be obtained at the registration desk by Friday noon. Dress, informal.

Presiding—Guy W. Horsley, *President.*
Welcome—Orville W. Wake, *President,* Lynchburg College.
Presentation of J. Shelton Horsley Research Award.
Report of Nominating Committee.
Report of Committee on Resolutions.
Report of Place of Meeting Committee.
Installation of Officers for 1951-1952.

8:30 P. M.—Address—Colonel William S. Stone, Medical Corps, Commandant, Army Medical Service Graduate School, Washington, D. C.
"Army Medical Research in National Defense."

SATURDAY, MAY 12, LYNCHBURG COLLEGE

9:00 A. M.—Section Meetings.

10:00 A. M.—Academy Council Meeting, Faculty Lounge, Westover Hall.
2:00 P. M.—Field Trips (see bulletin boards for further information).

Section of Agricultural Sciences

S. F. THORNTON, *Chairman*
E. MAPP DUNTON, JR., *Vice-Chairman*
R. C. CARTER, *Secretary*

FRIDAY, MAY 11, 1951 — 9:00 A. M. — LIBRARY

1. 9:00 An Attempt to Control Growth in a Willow Oak (*Quercus phellos*) Hedge with Maleic Hydrazide.
   W. S. Flory, Jr.; *The Blandy Experimental Farm, University of Virginia.*
2. 9:05 Improving the Storage Life of the Horse-radish.
   Lyle L. Davis; *Virginia Agricultural Experiment Station.*
3. 9:20 Pine Mouse Control by Ground Sprays.
   Frank Horsfall, Jr.; *Virginia Agricultural Experiment Station.*
4. 9:35 Some Aspects of Insect Control.
   R. N. Hofmaster; *Virginia Truck Experiment Station, Norfolk.*
5. 9:55 Sprays for Control of the Oriental Fruit Moth.
   M. L. Bobb; *Virginia Agricultural Experiment Station, Charlottesville.*
6. 10:10 The Influence of Biological Factors on Corn Earworm Control.
   D. E. Greenwood. *Virginia Truck Experiment Station, Norfolk.*
7. 10:25 Preliminary Trials of Methods of Planting and Fertilizing Corn Growing with Ladino Clover.
   Russell K. Stivers; *Virginia Agricultural Experiment Station.*
8. 10:45 Nitrogen—Soil Moisture Relationship in a Grape Vineyard.
   Wesley P. Judkins; *Virginia Polytechnic Institute.*
9. 11:05 The Influence of Certain Fertilizing Materials, Particularly Nitrogen Carriers, on the Soil Reaction in the Potato Row During the Growing Season.
   E. M. Dunton, Jr.; *Virginia Truck Experiment Station, Norfolk.*
10. 11:20 Management of Grass Leys to Lengthen the Grazing Season and Improve the Herbage Quality.
   R. E. Blaser, Willis Skrdla and T. Taylor; *Virginia Agricultural Experiment Station, Blacksburg and Middleburg.*

11. 11:40 The Effect of Continuous Pasture on the Distribution of Organic Matter in the Profile of the Native Forest Soil.
F. N. Goforth, H. F. Huckle, and S. S. Obenshain; *Virginia Agricultural Experiment Station.*

FRIDAY, MAY 11, 1951 — 2:00 P. M.

12. 2:00 The Activities of the Virginia Department of Agriculture.
Parke C. Brinkley; Commissioner, *Virginia Department of Agriculture, Richmond.*

13. 2:30 Plant Quarantines for the Control of Insects and Plant Diseases.
G. T. French; *Virginia Department of Agriculture, Richmond.*

14. 2:50 The Necessity, Provisions and Purpose of Hybrid Corn Legislation Passed by the 1950 Virginia General Assembly.
James W. Midyette, Jr.; *Virginia Department of Agriculture, Richmond.*

15. 3:10 Brucellosis Infections in Domestic Farm Animals.
W. L. Bendix; *Virginia Department of Agriculture, Richmond.*

16. 3:30 Differences in Nutritional Requirements Observed in Inbred Lines of Poultry. I. Manganese.
Clayton E. Holmes and James H. Bywaters; *Virginia Agricultural Experiment Station.*

17. 3:45 Organic Mercury as Fungicides.
R. H. Hurt; *Virginia Agricultural Experiment Station, Charlottesville.*

18. 4:00 The White Potato Breeding Program in Eastern Virginia and the Technique Used in Developing New Varieties.
M. M. Parker; *Virginia Truck Experiment Station, Norfolk.*

19. 4:15 The Effect of Environment on Some Genetic Characters in Horticultural Crops.
W. S. Flory, Jr.; *The Blandy Experimental Farm, University of Virginia.*

20. 4:30 The Influence of Moisture Content of Corn on the Dosage Requirements of Three Recommended Farm Grain Fumigants.
J. O. Rowell; *Virginia Agricultural Extension Service, Blacksburg.*

21. 4:45 Relation of Root Growth to Yield of Bush Lima Beans and Sweet Corn.
Flood S. Andrews; *Virginia Agricultural Experiment Station.*

4:55 Business meeting.

Section of Astronomy, Mathematics, and Physics

A. MARGUERITE RISLEY, *Chairman*

REUBEN E. ALLEY, JR., *Secretary*

FRIDAY, MAY 11, 1951—9:30 A. M.—ROOM 21, MAIN BUILDING

1. 9:30 Bell Design of Brass Musical Instruments.
   Clyde E. Miller; *Mathematics Department, Lynchburg College.*
2. 9:45 The Eigenvalues of the Harmonic Oscillators.
   E. J. McShane; *University of Virginia.*
3. 10:00 A High Temperature, High Precision Automatic Controller.
   Lynwood A. Cosby and J. F. Ryman; *Physics Department, Virginia Military Institute and Virginia Polytechnic Institute.*
4. 10:15 An Interpretation of Peculiar Motions in Terms of Galactic Structure.
   A. N. Vyssotsky; *Leander McCormick Observatory, University of Virginia.*
5. 10:30 The Astrometric Orbit of the Spectroscopic Binary Chi Draconis.
   Walter E. Mitchell; *Leander McCormick Observatory, University of Virginia* (Introduced by Harold L. Alden).
6. 10:45 On Orthogonal Transformation of Velocity and Acceleration.
   H. Y. Loh; *Physics Department, Virginia Polytechnic Institute.*
7. 11:00 The Circumradius of a Spherical Triangle.
   B. Z. Linfield, *University of Virginia.*
8. 11:15 Temperature Effects on Minimum Spark Ignition Energy.
   C. A. Gregory, Jr. and I. R. King; *Experiment Incorporated.*
9. 11:30 An Electrical Analogy Method for the Solution of Differential Equations.
   Reuben E. Alley, Jr.; *Physics Department, University of Richmond.*

FRIDAY, MAY 11, 1951—2:00 P. M.

10. 2:00 Photoelectric Photometry at the Leander McCormick Observatory.
    E. R. Dyer, Jr.; *Leander McCormick Observatory, University of Virginia.*

11. 2:15 Instrumentation for Photoelectric Photometry.
Donald F. Nieman, *Charlottesville* (Introduced by E. R. Dyer, Jr.).

12. 2:30 Transmission Line Electro-optical Shutter.
H. S. Morton and J. W. Beams; *University of Virginia.*

13. 2:45 A New High Constant Speed Rotating Mirror.
J. M. Watkins and J. W. Beams; *University of Virginia.*

14. 3:00 A Magnetically Suspended Equilibrium Ultracentrifuge.
A. Robeson, J. D. Ross, and J. W. Beams; *University of Virginia.*

15. 3:15 Resolution of the Cosmic Ray Components with Low Pressure Geiger Counters.
Peter A. Morris; *University of Virginia.*

16. 3:30 The Azimuthal Distribution of Photo-electrons Produced by Polarized Photons.
Frank L. Hereford; *University of Virginia.*

3:45 Business Session of Section.

17. 4:00 Discussion Concerning the Advisability of Organizing a Virginia Section of the American Association of Physics Teachers.
Led by Frederick L. Brown, *Rouss Physical Laboratory, University of Virginia.*

2:30 Business Session of Section.

Section of Bacteriology

J. DOUGLAS REID, *Chairman*
WILLIAM A. DORSEY, *Vice-Chairman*
W. FRENCH SKINNER, *Secretary*

FRIDAY, MAY 11, 1951—9:30 A. M. SMALL BIOLOGY LABORATORY, BIOLOGY BUILDING

1. 9:30 Activities of Soil Microorganisms as They Influence Availability of Plant Food in Soil Subjected to Stubble Mulch Tillage Practices.
S. J. R. Gamble and Fred S. Orcutt; *Virginia Polytechnic Institute.*

2. 9:55 The Production of Enterotoxin by Staphylococci Recovered from the Bovine Mammary Gland.
W. B. Bell and M. O. Veliz; *Virginia Agricultural Experiment Station, Virginia Polytechnic Institute.*

3. 10:20 Incidence of Canine Leptospirosis in Detroit, Michigan.
L. Lee Kupferberg; *School of Medicine, University of Virginia.*

4. 10:45 Extract Medium Cultivation Studies on *E. histolytica*
E. Clifford Nelson; *Medical College of Virginia.*

5. 11:10 Proteolytic Activity of Crude Extracts of *Lactobacillus casei.*
Leon Gonsherry and P. Arne Hansen; *University of Maryland.*

6. 11:30 A Comparative Study of the *in vitro* Activity of Certain Antibiotics against *E. coli, A. aerogenes, P. aeruginosa,* and *Proteus* sp.
J. Douglas Reid, Muriel M. Jones and Evelyn C. Bryce; *Medical College of Virginia.*

FRIDAY, MAY 11, 1951—2:00 P. M.

2:00 Business Meeting

7. 2:20 Yeast Extract as an Important Aid in Culturing Bacteria on Common Media as Evidenced by Respiration Rate and Extent of Growth.
Fred S. Orcutt, Kendall W. King, and W. R. Stafford; *Virginia Polytechnic Institute.*

8. 2:40 Role of Adenosine - 5 - phosphate in the Metabolism of Cysteine by *Proteus vulgaris and Escherichia coli.*
L. Lee Kupferberg; *School of Medicine, University of Virginia.*

9. 3:00 Microbiological Synthesis of Riboflavin to Enrich Swine Viscera Used for Poultry and Livestock Feed.
V. Frank Boyd, Jr., Fred W. Tylee and Fred S. Orcutt; *Virginia Polytechnic Institute.*

10. 3:20 Oxygen Uptake of *Mycobacteria.*
Medhat A. Hussein, P. Arne Hansen and Norman C. Laffer; *University of Maryland.*

Section of Biology

HORTON H. HOBBS, JR., *Chairman*
ROSCOE D. HUGHES, *Vice-Chairman*
A. M. SHOWALTER, *Secretary*

FRIDAY, MAY 11, 1951—9:00 A. M.—BIOLOGY ROOM, BIOLOGY BUILDING

1. 9:00 Abnormal Tooth Development in the Groundhog, *Marmota monax monax.*

Warwick R. West, Jr.; *Miller School of Biology, University of Virginia.*

2. 9:10 Sport Fisheries Management of Claytor Lake.
Dean A. Roseberg; *Commission of Game and Inland Fisheries, Richmond.*

3. 9:12 A Morphological Study of *Neoechinorhynchus cylindratus.*
Harry L. Hollaway, Jr.; *University of Richmond.*

4. 9:30 Studies on the Postembryonic Development of the Head and Gnathothoracic Appendages of the Crayfish, *Cambarus longulus longulus* Girard. (Decapoda, Astacidae).
Paul J. Osborne; *Miller School of Biology, University of Virginia.*

5. 9:42 Studies on Crayfish Ovarian Extracts.
Cornelia Anne Tuten; *Miller School of Biology, University of Virginia.*

6. 9:55 *Hemidactylium scutatum* (Schlegel): Nesting in Virginia.
John Thornton Wood; *College of William and Mary.*

7. 10:12 A Preliminary Report on the Size, Egg Number, Incubation Period, and Hatching in the Common Snapping Turtle, *Chelydra serpentina.*
Ray P. Ash; *College of William and Mary.*

8. 10:25 A Comparative Study of the Morphology of two Variants of *Prorhynchus stagnalis.*
Walter L. Richards, Jr.; *Miller School of Biology, University of Virginia.*

9. 10:30 The Aquatic and Semi-Aquatic Hemiptera of Virginia.
Marvin L. Bobb; *Virginia Agricultural Experiment Station, Research Laboratory, Charlottesville.*

10. 10:50 Cecidogenic Material in *Hormaphis hamamelidis.*
Ivey F. Lewis and Lucile Walton; *University of Virginia* and *Washington High School, Danville.*

11. 11:10 A Study of the Monogenetic Trematodes from the Gills of Westhampton Lake Fishes, with Additional Notes on Other Organisms Taken from the Gills.
William J. Hargis, Jr.; *University of Richmond.*

12. 11:22 The Effects of Inanition on the Fresh-Water Nemertean Worm, *Prostoma rubrum.*
Solomon Kadis; *Miller School of Biology, University of Virginia.*

13. 11:35 The Report of a Microscopic Observation Regarding a Specific Effect of Certain Pathogenic Bacteria on the Erythrocytes of Man.
Grace J. Blank; *College of William and Mary.*

11:45 Business Session: Election of Officers of the Section of Biology.

FRIDAY, MAY 11, 1951—2:00 P. M.

14. 2:00 Antibiotic Assay of Some Prairie Flowering Plants.
Lowell V. Heisey; *Bridgewater College.*

15. 2:18 Evidence of Ionization Currents in *Flabellula mira* as a Result of Motion within a Magnetic Field of 2300 Gauss.
Zoe Wells Carroll Black; *Mary Washington College of the University of Virginia.*

16. 2:35 Chromosomes of Certain West African Plants.
J. T. Baldwin, Jr. and Bernice M. Speese; *College of William and Mary.*

17. 2:50 Chromosome Numbers of Three Species of Amaryllis.
Thelma L. Ficker; *Blandy Experimental Farm, University of Virginia.*

18. 3:00 Locus of Natural Selection in an Experimental Population.
Max Levitan; *Virginia Polytechnic Institute.*

19. 3:12 A Natural Hybrid between *Celosia argentia* and *C. argentia var. Cristata.*
William F. Grant;*Blandy Experimental Farm, University of Virginia.*

20. 3:25 Growth Responses of *Datura stramonium* Embryos to Certain Nucleic Acid Components.
Jacques Rappaport; *Miller School of Biology and Blandy Experimental Farm, University of Virginia.*

21. 3:40 The Prothallus of *Asplenium montanum.*
Muriel Hegwood; *Miller School of Biology, University of Virginia.*

22. 3:50 The Alternation of Generations.
A. M. Showalter; *Madison College.*

SATURDAY, MAY 12, 1951—REGULAR SESSION 9:30 A. M.

8:30 Flowering Plants of the Alleghanies, a movie in color.
A. B. Massey, *Chairman, Flora Committee.*

23. 9:30 The Distribution of *Xerophyllum asphodeloides* in the Massanutten Mountains.
Lena Artz; *Waterlick, Virginia.*

24. 9:42 A Naturally-Occurring Triploid Juniper.
M. L. Stiff; *Blandy Experimental Farm, University of Virginia.*

25. 9:55 New or Interesting Bryophytes Collected by Bayard Long in Southeastern Virginia.
Paul M. Patterson; *Hollins College.*

26. 10:00 The Occurence and Ontogeny of Hydathodes in the Leaves of *Hygrophila polysperma*.
W. M. Reams, Jr.; *University of Richmond.*

27. 10:20 The Floral Morphology of *Cenchrus, Pennisetum, Setaria* and *Ixaphorus*.
Ernest R. Sohns; *College of William and Mary.*

28. 10:35 Influence of 2, 4-dichlorophenoxyacetic acid on Germination of Seeds, their Subsequent Growth Pattern, and their Chemical Composition.
William Robert Jenkins; *Miller School of Biology, University of Virginia.*

29. 10:48 Orcein, Orange G, and Picric Acid Staining as Applied in Skin and Fiber Studies.
Lubow A Margolena and Ethel H. Dolnick; *Animal Fiber Laboratory, Bureau of Animal Industry U.S.D.A.*

30. 11:00 A New Method for Tagging the Immature Edible Blue Crab, *Callinectes sapidus* Rathbun.
Willard A. VanEngel; *Virginia Fisheries Laboratory.*

31. 11:08 Expanding Seed-Oyster Production in Virginia
Jay D. Andrews; *Virginia Fisheries Laboratory.*

32. 11:25 Range and Habitat of the Clam, *Polymesoda caroliniana* in Virginia.
Jay D. Andrews; *Virginia Fisheries Laboratory.*

33. 11:45 Gray's Manual of Botany, 8th Edition and Its Influence in Developing a Virginia Flora.
A. B. Massey; *Virginia Polytechnic Institute.*

34. 12:00 Some Problems and Difficulties in the Study of the Myxophyceae.
Elton C. Cocke, *Wake Forest College, N. C.*

Section of Chemistry

J. ROBERT TAYLOR, *Chairman*

W. SCHUYLER MILLER, *Secretary*

FRIDAY, MAY 11, 1951—9:30 A. M.—AUDITORIUM, MAIN BUILDING

1. 9:30 Some Causes of Color of Complex Ions in Aqueous Solutions.
James W. Cole, Jr. and Lewis G. Cochran; *University of Virginia.*

2. 9:45 Spectrochemical Analysis for Trace Elements in Blood.
Ralph E. Thiers and John H. Yoe; *Pratt Trace Analysis Laboratory, School of Chemistry, University of Virginia.*

3. 10:00 Spectrophotometric Studies on the Reaction of Platinum with Compounds Containing the p-Nitrosophenylamino Group.
J. Hack Kirkland and John H. Yoe; *Pratt Trace Analysis Laboratory, School of Chemistry, University of Virginia.*

4. 10:15 New Syntheses of Aromatic Phosphorus Compounds.
Alfred Burger and Norman D. Dawson; *University of Virginia.*

5. 10:30 Chemical Analyses of Oyster, Clam, Mussel, Anomia, and Barnacle Shells.
A. R. Armstrong *College of William and Mary.*

6. 10:40 The Reaction of Iron with Several Substituted Salicylic Acids.
Bernard Howard and A. R. Armstrong; *College of William and Mary.*

7. 10:55 Progress Report on Chromatographic Adsorption Qualitative Analysis for Metal Ions.
Harriet H. Fillinger and Students; *Hollins College* (Paper presented by Lois Ann Trafton).

8. 11:00 Preparation of Standard Hydrochloric Acid Solution from Constant Boiling Solution.
J. B. Lucas; *Virginia Polytechnic Institute.*

9. 11:10 The Determination of the Rare Earth Elements in Phosphate Rock.
C. W. Bondurant and J. B. Lucas; *Virginia Polytechnic Institute.*

10. 11:30 The Preparation and Some Reactions of a New Silicon Hydrocarbon.
H. Ritchey and H. C. Pitot; *Virginia Military Institute.*

FRIDAY, MAY 11, 1951—2:00 P. M.

11. 2:00 The Reducing Action of Different Metals in Liquid Ammonia.
Robert C. Krug and George J. Hsieh; *Virginia Polytechnic Institute.*

12. 2:30 Electrodeposition of Thin Films of Titanium from Aqueous Solution.
Francis J. Denise and Henry Leidheiser, Jr.; *Virginia Institute for Scientific Research.*

13. 2:45 The Development of the Electronic Theory of Aromatic Cyclodehydration.
Frank A. Vingiello; *Virginia Polytechnic Institute.*

14. 3:15 The Synthesis and Cyclization of Some 2-(substituted

benzyl)benzophenones.
Frank A. Vingiello and James G. Van Oot; *Virginia Polytechnic Institute.*

15. 3:30 Urethans and Ureas from Cyclic Derivatives of Tris (hydroxymethyl) aminomethane.
J. Stanton Pierce and J. L. Rush, Jr.; *University of Richmond.*

16. 3:40 Acylation of Tris (hydroxymethyl) aminomethane and Cyclic Derivatives.
J. Stanton Pierce, Carl D. Lunsford, and Theodore Katz; *University of Richmond.*

17. 3:55 A New Colorimetric Reagent for Molybdenum.
Fritz Will and John H. Yoe; *Pratt Trace Analysis Laboratory, University of Virginia.*

18. 4:10 A New Colorimetric Reagent for Zinc.
Richard M. Rush and John H. Yoe; *Pratt Trace Analysis Laboratory, University of Virginia.*

SATURDAY, MAY 12, 1951—9:00 A. M.

19. 9:00 Effect of Substitution Degree on Fractionation of Cellulose Nitrate.
P. C. Scherer and Li-Hsi Lou; *Virginia Polytechnic Institute.*

20. 9:10 Effect of Substitution Degree on Fractionation of Ethyl Cellulose.
P. C. Scherer and J. G. Iacoviello; *Virginia Polytechnic Institute.*

21. 9:20 A Quantitative Measure of the Oxidation Rates of Various Faces of Copper Single Crystals.
John V. Cathcart; *University of Virginia.*

22. 9:35 Electrochemical Properties of Copper Single Crystals.
Lewis B. Johnson, Jr.; *University of Virginia.*

23. 9:50 Different Degrees of Wettability of Crystallographic Planes of Copper Single Crystals.
Jerome Kruger; *University of Virginia.*

24. 10:05 X ray Studies of Oxide Films on Copper Single Crystals.
Kenneth R. Lawless; *University of Virginia.*

25. 10:20 Methods of Expressing Surface Energy.
Peter B. Sherry; *University of Virginia.*

26. 10:40 Catalytic Decomposition of Carbon Monoxide on Faces of a Nickel Single Crystal.
J. Bruce Wagner; *University of Virginia.*

27. 11:00 The Effect of Metallic Salts on the Production of Acid by

Saliva Containing Sucrose.
J. D. Smith and J. C. Forbes; *Medical College of Virginia.*

Section of Education

R. CLAUDE GRAHAM, *Chairman*

Z. T. KYLE, *Secretary*

FRIDAY, MAY 11, 1951 — 9:00 A. M. — ROOM 14, MAIN BUILDING

The Accreditation of Virginia Schools

1. 9:00 Standards for Accrediting the Secondary Schools of Virginia.
Thomas T. Hamilton; *Director of Secondary Education.*

2. 10:00 Standards of the Commission on Secondary Schools of the Southern Association of Colleges and Secondary Schools.
B. L. Stanley, *Chairman of the Virginia State Committee, and* John Page Williams, a member of the Virginia *Committee and Head-master, St. Christopher's School, Richmond.*

3. 10:40 The Elementary School Principalship.
Davis Y. Paschall, *Director of Elementary Education.*

FRIDAY, MAY 11, 1951 — 2:00 P. M.

4. 2:00 Report of Teaching Success of Recent Graduates of Radford College, as Measured by: (a) Superintendents, Principals, and Supervisors; and (b) Graduate's Estimate of Extent College Courses Contributed to Teaching Success.
Minor Wine Thomas; *Radford College.*

5. 2:30 Is the Lecture Method of Instruction Outmoded in Education.
A. W. Hurd; *Medical College of Virginia.*

6. 3:00 Relationships Among Certain Educational Variables in Some County Elementary Schools.
Alonzo M. Myster and Esther V. Short; *Virginia State College.*

7. 3:30 The Language Development of Bilingual, Identical Twins, in English and Chinese, with Educational Implications for Language Teaching.
E. Hart Westbrook; *Richmond.*

Section of Engineering

R. F. L. GILDEA, *Chairman*

B. A. NIEMEIER, *Secretary*

FRIDAY, MAY 11, 1951—9:00 A. M.—ROOM 12, MAIN BUILDING

1. 9:00 Rigid Space Frame Analysis.
   D. H. Pletta and R. J. Tedaldi; *Virginia Polytechnic Institute.*
2. 9:15 Analysis of Fink Trussed Bents by Moment and Thrust Distribution.
   D. H. Pletta and V. J. Vitagliano; *Virginia Polytechnic Institute.*
3. 9:35 Experimental and Theoretical Aspects of Skewed Rigid Frame Bridges.
   D. H. Pletta, V. G. Szebehely, and M. A. Garcia; *Virginia Polytechnic Institute.*
4. 10:00 Approximate Matrix Analysis of Two-Dimensional Structural Frames.
   W. P. Murden, Jr.; *Virginia Polytechnic Institute.*
5. 10:20 The Improved Hydraulic Analogy.
   V. G. Szebehely and L. F. Whicker; *Virginia Polytechnic Institute.*
6. 10:45 The Use of Stereographic Photography to Determine the Roughness Factor Coefficient in Fluid Flow Measurements (with Three-Dimensional Color Slides).
   R. H. Tice; *U. S. Geological Survey.*
7. 11:15 Investigation of the Motion of a Sphere in a Semi-Infinite Ideal Fluid by Means of the Phase Plane.
   S. M. Gay, E. Q. Smith, and V. G. Szebehely; *Virginia Polytechnic Institute.*
8. 11:35 Influence of the Second Coefficient of Viscosity.
   V. G. Szebehely; *Virginia Polytechnic Institute.*

FRIDAY, MAY 11, 1951—1:30 P. M.

9. 1:30 New Analogy for Investigating Compressible Flow Phenomena.
   V. G. Szebehely and O. G. Barnes, Jr.; *Virginia Polytechnic Institute.*
10. 1:45 Alkali Reaction of Concrete Structures in Virginia.
   P. L. Melville; *Virginia Council of Highway Investigation and Research.*
11. 2:10 The Measurement of Moisture Content in Concrete.
   R. W. Czaban; *University of Virginia.*

12. 2:30 The Installation of a Meteorological Research Station at the University of Virginia.
R. E. L. Gildea; *University of Virginia.*

13. 2:45 A Rational Approach to Waste Treatment Based on Studies of Biological Processes.
P. H. McGauhey and E. E. Thompson; *Virginia Polytechnic Institute.*

14. 3:00 The Application of the Dropping Mercury Electrode to the Study of Respiration Rates of Micro-organisms Associated with Waste Treatment.
P. H. McGauhey and L. G. Rich; *Virginia Polytechnic Institute.*

15. 3:15 The Manometric B.O.D. of Industrial Waste Utilizing High Concentrations of Micro-organisms.
S. E. Ketner and P. H. Watkins; *Virginia Polytechnic Institute.*

SATURDAY, MAY 12, 1951—9:00 A. M.

16. 9:00 Ultrasonic Coagulation of Phosphate Tailing—Part II.
Dudley Thompson; *Virginia Polytechnic Institute.*

17. 9:20 Development Studies on the Production of Sodium Trichloroacetic Acid Herbicide.
F. C. Vilbrandt and W. V. Brown; *Virginia Polytechnic Institute.*

18. 9:35 Elimination of Insect Contamination from Bread Corn.
N. F. Murphy and C. L. Kingrea; *Virginia Polytechnic Institute.*

19. 9:50 The Determination of the Bed-Wall Coefficient of Heat Transfer in an Externally Heated Fluidixed Bed.
H. R. Sanders, R. Peterson, and F. W. Bull; *Virginia Polytechnic Institute.*

20. 10:05 Heat Transfer from Vertical Finned Tubes to Boiling Organic Liquids.
O. E. Tarbell, Jr., and R. M. Hubbard, *University of Virginia.*

21. 10:25 Thermal Vs Catalytic Cracking in Standard Test Unit.
E. Ruehl and F. W. Bull; *Virginia Polytechnic Institute.*

22. 10:40 Pyrolysis of Fluidized Oil Shale.
J. M. Carr and F. W. Bull; *Virginia Polytechnic Institute.*

23. 11:05 Catalyst's Evaluations for Hydrogenation of Midlothian Coal.
R. G. Harmon, L. D. Jordan, and F. W. Bull; *Virginia Polytechnic Institute.*

24. 11:30 Solubilities in the System Sodium Sulfate-Isopropanol-Water.
W. B. Blakey, L. R. Powers, and O. L. Updike; *University of Virginia.*

25. 11:50 A New Chemical Coating for Aluminum.
R. L. Scott and N. F. Murphy; *Virginia Polytechnic Institute.*

Section of Geology

ALLEN SINNOTT, *Chairman*

WILLIAM H. BROWN, *Vice-Chairman*

WILLIAM T. PARROTT, *Secretary*

FRIDAY, MAY 11, 1951—9:00 A. M.—LARGE BIOLOGY LABORATORY, BIOLOGY BUILDING

9:00 Announcements, Committee Reports.

1. 9:10 Recent Investigations of the Emery Deposits in Virginia.
Arthur A. Pegau and Gerald M. Friedman; *Virginia Geological Survey and University of Cincinnati* (Presented by Arthur A. Pegau.)

2. 9:20 Fluorescence and Petrology.
William P. Shulhof; *University of Virginia.*

3. 9:30 Ordovician Bioherm in Roanoke Valley, Virginia.
F. D. Etheredge, Frank G. Lesure, and H. S. Page; *Virginia Polytechnic Institute* (Presented by Frank G. Lesure; Introduced by Byron N. Cooper).

4. 9:45 Age Relationships of the Lincolnshire, Whistle Creek, and Associated Limestones in Western Virginia.
Byron N. Cooper; *Virginia Polytechnic Institute.*

5. 10:00 A Preliminary Study of the Occurrence of Groundwater in Crystalline Rocks of Albemarle County.
A. C. Walker; *Virginia Geological Survey.*

6. 10:10 Evidences of Crystal Megashearing in Virginia.
B. Ashton Keith; *Director of the Institute of Science, Washington, D. C.*

7. 10:25 Major Structural Features in the Lynchburg Quadrangle.
William R. Brown; *University of Kentucky.*

8. 10:45 Some Injurious Minerals in Highway Aggregates.
William T. Parrott; *Virginia Department of Highways.*

9. 10:55 A Contribution to the Geochemistry of the Lead and Zinc Ores in the Timberville Area, Virginia.
Jack Green; *Columbia University.*

10. 11:10 Some Lithologic Variations in Ordovician Limestones in the Vicinity of Lexington, Virginia.
Allan S. Horowitz; *Washington and Lee University.*

11. 11:20 Mineralogical Studies of the Sediments of Slate River, Buckingham County, Virginia.
Wallace R. Oref and James A. Parker; *Washington and Lee University* (Presentd by James A. Parker).

12. 11:30 Mineralogical Studies of the Sediments of Rivanna River, Fluvanna, and Albemarle County, Virginia.
Allan S. Horowitz and Thomas S. Miller; *Washington and Lee University* (Presented by Thomas S. Miller).

13. 11:40 Petrography of Some Valley Dykes.
H. Cooke; *University of Virginia.*

14. 11:50 Some Recent Developments in Support of the Virginia Geological Survey.
Marcellus H. Stow; *Washington and Lee University.*

12:00 Announcements.

FRIDAY, MAY 11, 1951—2:00 P. M.

15. 2:00 The Composition of the Euhedral Feldspar Crystals of the Catoctin Greenstone.
James L. Eades; *University of Virginia.*

16. 2:10 Petrogenesis of Some Late Minerals in the Catoctin Greenstone.
C. Hyser; *University of Virginia.*

17. 2:20 A Study of Some Virginia-West Virginia Coals.
Robert S. Young; *University of Virginia.*

18. 2:35 A Preliminary Restudy of the Goose Creek Diabase.
D. S. Robertson; *University of Virginia.*

19. 2:45 Some Features of Alaskan Geology—A Travelogue.
D. J. Cederstrom; *District Geologist for Alaskan Ground Water Branch, United States Geological Survey.*

20. 3:15 The Background of Uniformitarian Geology.
Joseph K. Roberts; *University of Virginia.*

21. 3:30 A Pre-Cambrian Fault Breccia in the Catoctin Formation in Virginia.
Wilbur A. Nelson and Robert S. Young; *University of Virginia* (Presented by Wilbur A. Nelson).

3:40 Business Meeting
Announcements, Reports of Committees, and Election of officers.

SATURDAY, MAY 12, 1951—8:15 A. M.

Geological Field Trip.

Details of trip and place of assembly will be announced at the meetings on Friday.

Section of Medical Sciences

ERLING S. HEGRE, *Chairman*

DAN T. WATTS, *Secretary*

FRIDAY, MAY 11, 1951—9:30 A. M.—ROOM 1, MAIN BUILDING

1. The Effect of Pentobarbital, Morphine, and Ether on the Blood Glucose of Rabbits.
   D. T. Watts; *Department of Pharmacology, University of Virginia Medical School.*
2. Gross Composition of the Fat-free Mammalian Body.
   Grover C. Pitts; *Department of Physiology, University of Virginia Medical School.*
3. The Effect of Cortisone on Wound Healing.
   John Paul Carter, Edwin P. Lehman, J. F. A. McManus, and E. Meredith Aldrich; *Department of Surgery and Gynecology and Department of Pathology, University of Virginia Medical School.*
4. Intimal Aortic Lipoid Following Cortisone and ACTH Therapy in Younger Age Groups.
   E. M. Etheridge and Cornelia Hoch-Ligeti; *Department of Pathology, University of Virginia Medical School.*
5. Effects of Progesterone on the Basal Body Temperature of Normal Adult Human Males.
   Douglas E. Bragdon; *Department of Anatomy, University of Virginia Medical School.*
6. A Study of the Phosphate Turnover in the Human Erythrocyte.
   D. R. H. Gourley; *Department of Pharmacology, University of Virginia Medical School.*
7. Sulphydryl Group Changes During Urease Action.
   Henry E. Evert; *Department of Pharmacology, University of Virginia Medical School.*
8. Preliminary Studies on the Effect of Hormones on the Electrolyte Pump in Frog Skin.
   Ernst A. Huf and Irving Fritz; *Department of Physiology, Medical College of Virginia.*
9. Observations on the Nicotinolytic Activity of Some Aralkyl Amines.
   P. S. Larson, C. B. Van Slyke, J. K. Finnegan, and H. B. Haag; *Department of Pharmacology, Medical College of Virginia.*

10. Mounting Brain Specimens in Plastic.
Louise L. Jones; *Department of Anatomy, Medical College of Virginia.*

11. The Trophoblast of a Young Human Embryo.
James E. Kindred; *University of Virginia Medical School.*

12. Embryonic Lens Induction in the Chick.
M. S. McKeehan; *Department of Anatomy, University of Virginia Medical School.*

13. Motion Pictures of Tissue Reactions in Tadpoles to Implants of Inert and Active Foreign Substances.
Carl C. Speidel; *Department of Anatomy, University of Virginia Medical School.*

FRIDAY, MAY 11, 1951—2:00 P. M.

14. Relationship between Blood Alcohol Levels and Acute Respiratory Failure.
Teresa Silverman, Sidney Kaye, and Harvey B. Haag; *Departments of Pharmacology and Legal Medicine, Medical College of Virginia.*

15. Studies on the Effect of Alcohol on the Adrenal Glands of Rats.
J. C. Forbes and G. M. Duncan; *Department of Health, State of Virginia, and Department of Biochemistry, Medical College of Virginia.*

16. Comparison of Chloride and Thiocyanate Space for Various Organs, Especially of Muscle in Normal and Pathological Conditions.
E. Fischer, H. V. Skowlund, E. A. White, M. J. Bratton, and B. A. Chevalier; *Medical College of Virginia.*

17. Methods of Microcalorimetry.
C. L. Gemmill, C. R. Bauer, M. J. Lover, F. Holler, and D. Venable; *Department of Pharmacology, University of Virginia Medical School.*

18. The Heat of the Enzymatic Inversion of Sucrose.
Carl R. Bauer and Chalmers L. Gemmill; *Department of Pharmacology, University of Virginia Medical School.*

19. Oxygen Administration to Patients with Pulmonary Fibrosis and Emphysema.
John L. Guerrant; *Department of Internal Medicine, University of Virginia Medical School.*

20. The Diagnosis of Brain Tumors with Diiodofluorescein Using a Crystal Counter and a Photoelectric Multiplier—Physical and Clinical Implications.
Kenneth Crispell, Alden Stephenson, and Frank Hereford; *Department of Internal Medicine and School of Physics, University of Virginia.*

21. Investigations on the Histochemical Demonstration of Carbohydrates by the PAS Method.
J. F. A. McManus and Cornelia Hoch-Ligeti; *Department of Pathology, University of Virginia Medical School.*

22. Cytologic Criteria of Malignancy; Critical Comments on the Morphologic Diagnosis of Neoplasia.
S. Miles Bouton, Jr.; *Lynchburg General Hospital.*

23. Isoimmunization by a New Blood Factor in Tumor Cells.
Philip Levine, O. B. Bobbitt, R. K. Waller, and A. B. Kuhmichel; *Ortho Research Foundation, Raritan, N. J., University of Virginia Medical School, and Medical College of Virginia.*

24. Sakaguchi Tube Test for Arginine Applied to Histochemistry.
T. N. Warren and J. F. A. McManus; *Departments of Clinical Pathology and Pathology, University of Virginia Medical School.*

25. The Demonstration of the Intercapillary Space of the Human Renal Glomerulus.
J. F. A. McManus, Charles H. Lupton, Jr., Louis S. Sparkman, Jr.; *School of Pathology, Department of Medicine, University of Virginia.*

26. Changes in the Blood and Peripheral Vascular Bed Produced by Experimental Metrazol Administration.
J. F. Kell, Jr., G. R. Hennigar, and E. C. Hoff: *Department of Neurology, Medical College of Virginia.*

27. The Effect of Lactic Acid Production on In Vitro Acid Secretion from the Gastric Mucosa of a Bullfrog.
Leslie E. Edwards and Joyce A. Wills; *Department of Physiology, Medical College of Virginia.*

Section of Psychology

JOHN N. BUCK, *Chairman*

STANLEY B. WILLIAMS, *Secretary-Treasurer*

FRIDAY, MAY 11, 1951—8:45 A. M.—ROOM 16, MAIN BUILDING

1. 8:45 The Incidence, Assigned Motives, and Successes of Attempted Suicides, in Certain Chinese Cities, with Comparative Intercultural Factors.
C. Hart Westbrook; *Richmond.*

2. 9:00 The Effect of Thyroxin on Conditioning and Extinction.
Henry Ellis and Eugene Kanter; *College of William and Mary.*

3. 9:15 Test-versus Item-reliability with Learning Factor Minimized.
Harold Good and Burton R. Wolin; *College of William and Mary.*

4. 9:30 Changes in "Social Maturity" from Freshman to Senior Year in College.
Kathryn Hill and Elise Gamble; *Hollins College.*

5. 9:45 Rorschach and Scholastic Averages.
Marjorie Brownell; *Randolph-Macon Woman's College.*

6. 10:00 Student's Aid in Planning Professional Courses.
A. W. Hurd; *Medical College of Virginia.*

7. 10:15 The Ethical Discrimination of Various Groups of College Women, Based on Hollingworth's Scale.
Helen K. Mull; *Sweet Briar College.*

8. 10:30 Further Evidence for Secondary Reinforcement in Specific Hunger Behavior.
John K. Bare; *College of William and Mary.*

9. 10:45 Differential Food Preference as a Function of Secondary Reinforcement.
Paul Spector; *University of Virginia.*

10. 11:00 Simultaneous Galvanic and Faradic Stimulation of the Skin.
Jack A. Vernon; *University of Virginia.*

11. 11:15 The Frequency Response Characteristics of the Skin as a Medium for Vibratory Forces.
Carl E. Sherrick; *University of Virginia.*

12. 11:30 A Comparison of the Effects of Peripheral Light Variation on Tachistoscopic Presentation of Digits.
Andrew W. Gottschall, Jr.; *Washington and Lee University.*

13. 11:45 Conditioning of a Verbal Guessing Response with Subjects Unable to Verbalize the Solution.
Burton R. Wolin; *College of William and Mary.*

FRIDAY, MAY 11, 1951—1:45 P. M.

1:45 Business Meeting.

14. 2:30 The Effect of Order of Presentation upon "Estimates of Mildness" in Certain Cigarette Tests.
William M. Hinton; *Washington and Lee University.*

15. 2:45 The Interdependence of Psychophysical Judgments of Auditory Differential Intensities.
Williard F. Day; *University of Virginia.*

16. 3:00 Preliminary Investigation of the Conditions Determining the Efficiency of Multiple Task Performance.
Alec J. Slivinske; *University of Virginia.*

17. 3:15 Equivalence of Response Criteria for the Evaluation of Communication Systems.
Howard Reuben; *University of Virginia.*

18. 3:30 Transfer of Response of Discriminating as Measured by Habit Reversal.
William H. Morse; *University of Virginia.*

19. 3:45 Stereotyping of Negroes and Whites: an Analysis of Magazine Pictures.
Nancy King and Barbara Griffith; *Randolph-Macon Woman's College.*

20. 4:00 New Perspective on Diagnosis.
Arthur J. Bachrach; *University of Virginia.*

21. 4:15 The Case of the Obliging Diagnosis.
John T. Payne; *Morganton State Hospital, North Carolina.*

Section of Teachers of Science

W. I. NICKELS, JR., *Chairman*

SUSIE V. FLOYD, *Chairman-Elect*

MARTHA W. DUKE, *Secretary*

FRIDAY, MAY 11, 1951—9:30 A. M.—ROOM 13, MAIN BUILDING

Announcements.
W. I. Nickels, Jr.; *Lane High School, Charlottesville.*

1. The Place of Geology in the High School.
R. S. Edmundson and John D. Tomlinson; *University of Virginia and Lane High School, Charlottesville.*

2. The Study of Surface Chemistry With the Aid of Large Metal Crystal. (Illustrated.)
Allan T. Gwathmey; *University of Virginia.*

FRIDAY, May 11, 1951—2:00 P. M.

Business Meeting.

3. The Electron Theory in Balancing Chemical Equations.
Mary E. Kapp and Esther Shreve Ruffin; *Richmond Professional Institute and St. Catherine's School, Richmond.*

Section of Statistics

CHARLES M. MOTTLEY, *Chairman*

L. WEISS, *Vice-Chairman*

M. E. TERRY, *Secretary*

FRIDAY, MAY 11, 1951—9:30 A. M.—ROOM 22, MAIN BUILDING

1. 9:30 A Dairy Grazing Experiment Using a Latin Square.
N. R. Thompson; *North Carolina State College, Raleigh,* and *Virginia Polytechnic Institute.*

2. 9:50 Some Sequential Fish Tagging Models.
E. L. Cox; *North Carolina State College, Raleigh.*

3. 10:10 Inadvertent Mixing of Samples.
L. Weiss; *University of Virginia.*

4. 10:30 An Application of the Percent Effect Curve to the Sub-acute Toxicity Studies of Hydrazine on Rats.
I. A. De Armon; *Army Chemical Center, Maryland.*

5. 11:10 An Experiment in Grouping Data.
A. M. Myster; *Virginia State College, Petersburg.*

6. 11:30 Quality Control in the Wood Industry.
R. C. Rhodes; *Virginia Polytechnic Institute.*

FRIDAY, MAY 11, 1951 — 2:00 P. M.

7. 2:00 Sequential Methods in Subjective Tests.
G. Lombardi; *Virginia Polytechnic Institute.*

8. 2:20 Some New Incomplete Block Designs.
B. Harshbarger; *Virginia Polytechnic Institute.*

9. 2:45 A Significance Test for Differences between Ranked Treatments in the Analysis of Variance.
D. B. Duncan; *Virginia Polytechnic Institute.*

10. 3:25 Theory of Regression for a Binomially Distributed Variate.
G. W. Suter; *Crop Reporting Service, Richmond.*

3:50 Business Session.

SATURDAY, MAY 12, 1951—9:00 A. M.

11. 9:00 Rank Analysis of Incomplete Block Designs.
R. A. Bradley and M. E. Terry; *Virginia Polytechnic Institute.*

12. 9:40 Systematic Military Programming.
M. A. Geisler; *Standards Evaluation Branch, Department of the Air Force, Washington, D. C.*

13. 10:20 Scoring of Bombing Accuracy.
W. L. Deemer; *United States Air Force, Washington, D. C.*

14. 11:00 Single Link Designs.
J. Youden; *Bureau of Standards, Washington, D. C.*

15. 11:40 Sampling of Ear Corn for Damage.
C. Moffett; *Department of Agriculture, Richmond.*